A Sewage Destructor.

Messrs. Manlove, Alliott, Fryer & Co., Nottingham, the patentees, furnish the following interesting description of their six-cell destructor, as erected at Leeds, Derby, Bradford, Bolton, etc. The destructor represents externally a mass of brickwork 22 feet wide, 24 feet deep, and 12 feet 6 inches in height, all well tied and bolted together with strong iron rods, which perforate the whole structure. Internally it consists of a double set of three cells placed back to back, or in all six compartments, each of which is in direct communication with a chimney. A cell, therefore, constitutes a separate furnace, consisting of a cavity enclosed by a reverberatory arch lined with firebricks; it is supplied with a hearth for the reception of the material to be consumed, from which it passes into the furnace proper; the fire-bars are placed in an acutely slanting position in order to favor the passage of the heavier and incombustible portions downwards to the front doors, and thereby facilitate the removal of clinkers, etc. The top of the destructor forms a perfectly flat platform, having an opening over each cell, into which the refuse to be burnt is shot from the collecting-carts. When the furnaces are in full work the clinkers require to be withdrawn about every two hours, and at about the same interval the attendant on the top of the destructor commences shovelling in a fresh charge. When working at its full power, the destructor will treat about 6 or 7 tons of refuse per cell in twenty-four hours; therefore six cells will do about 40 tons, which should equal a town with a population of 30,000. The cells are so constructed that others may be added at any future time as the town increases without any alteration of the existing furnaces. A large amount of waste heat necessarily results from the process, and the hot gases thus generated are utilized on their way to the chimney, and made to pass through a multitubular boiler. The steam thus generated may be used for driving an engine for slop-washing, grinding clinker, cutting corn, steam-disinfecting, or any purpose useful to the corporation. The cost of iron-work for a six cell "Fryers's Patent Destructor," with all necessary tools, dampers, clinker and ash barrows, including royalty and plans with supervision, is 1,023*l*. The cost of machinery, to include boiler, engine, and mills, is about 1,000*l*. The brickwork of the cells, with chimney and general building, would be about 1,500*l*.—*Sanitary World.*

The National Survey.

WASHINGTON, June 28.—The coming fiscal year's work of the Geological Survey has been mapped out by Major Powell, and the plans have received the approval of Secretary Lamar. Topographical parties will continue the work already begun in Massachusetts and New Jersey, whither they have been invited by the State authorities, which co-operate with the Government to the extent of defraying one-half the expense of the survey. It is expected that the work in these States will be completed within two years. The mapped areas of the coal and iron bearing regions of the East will be considerably enlarged. These are three in number, namely, the Appalachian district, extending from Maryland to Georgia and Alabama; portions of Missouri, Kansas and Arkansas, and a portion of Texas. Geographical surveys will also be continued in Arizona, New Mexico, Califronia Oregon, Montana and Idaho, and in the Yellowstone Park. Several astronomical parties will also be sent out to establish starting points for the new surveys to be begun next year.

The operations of the Geological Survey in the east are of recent undertaking, and geologists of ripe western experience, numbering among them men of well recognized eminence in the scientific world, are being drafted to the eastern fields to follow closely upon the footsteps of the geographers. Prof. Pumpelly will study the archæan rocks of the eastern portion of the United States, exending from New-England southward to Georgia. This includes the study of the origin, age, and structure of the Appalachian system. Prof. Shaler, in charge of the Atlantic Coast Division, studies the elevations and depressions of the coast, the conditions under which land is formed by the accumulations of sand bars and reefs, and the growth of peat bogs, and their availability for agriculture when reclaimed by drainage. Prof. Gilbert deals with the rocks of the Appalachian region of later than archæan formation. These are the richest coal-bearing strata of the continent, and much of the iron of this region is found within them Prof. Roland D. Irving is studying the copper bearing formations of the Lake Superior region. Mr. Lawrence C. Johnson is to examine the formations of Northern Louisiana, with reference to the development of the iron ores which have recently been discovered there, the value of which, however, is as yet unknown. Dr. Hayden continues his work in the Upper Missouri region. Mr. Arnold Hague will further study geysers of the Yellowstone Park and their relations to the volcanic formations of that district. In prosecuting this work Mr. Hague has carried on experiments in the laboratory, and during the last winter has succeeded in producing small geysers by the generation of steam under peculiar conditions. Mr. S. T. Evans will work in the mining districts of Colorado, devoting special attention to the discovery of the sources and the supply of artesian waters, problems in which all the dwellers, in the so-called arid regions have a direct and deep interest. Mr. George Becker is engaged in the study of the quicksilver deposits of the Pacific coast. Mr. Curtis is at the work among the silver-lead deposits of Utah, and Capt. Clarence F. Dutton, is examining the volcanic phenomena of the Cascade range. Prof. Chamberlin continues the study of the glacial formations of the northern part of the United States.

Forestry in Europe.

Of all the forest wealth of France there only remain, in round numbers, comprising the various categories of proprietors, 22,000,000 acres, the greater part of which is composed of woods of simple growth, of an almost null produce; moreover, there is an almost equal extent of uncultivated grounds, which are generally the remains of ancient forests that have been destroyed.

From 1791 to the present time the extent of woodland property has constantly decreased. The State owned, in 1791, according to reports of that epoch, 4,213,088 acres; 1795, 6,406,939 acres; 1820, 3,001,362 acres; 1830, 2,777,148 acres; there now only remains 2,389,887 acres.

Since the year 1820 more than 741,342 acres of forest belonging to the State have been sold to private individuals. The tract of communal forests and of woodland owned by private persons has decreased in still greater proportion. For the last fifty years more than 1,112,013 acres of forests owned by private owners have been cut down.

Austria, in the same period, from 1790 to 1880, increased its forest superficies by 694,871 acres.

During the past twenty years the forests of Bavaria have gained 129,971 acres. The same progression is observed in Switzerland and in the German States.

A forest can not be valued merely according to its extent. An acre covered with trees one hundred, one hundred and fifty or two hundred years old, will give without doubt, in the same period much more considerable and useful product than an acre of trees cut every fifteen, twenty or twenty-five years, the proportion being as 7 is to 4.

France is, in all woodland respects, inferior to neighboring countries. The danger of this situation is brought to light by the following figures: The importation of wood in 1830 amounted to $4,246,000. It now amounts to $53,654,000, an increase of $49,408,000 in fifty years. The exports only increased $6,390,000.

Germany, from which France received in 1865 only $2,500,000, now sends about $6,948,000 receiving in exchange only $482,500 worth of forest products. Germany supplies a great part of the French railroad sleepers.

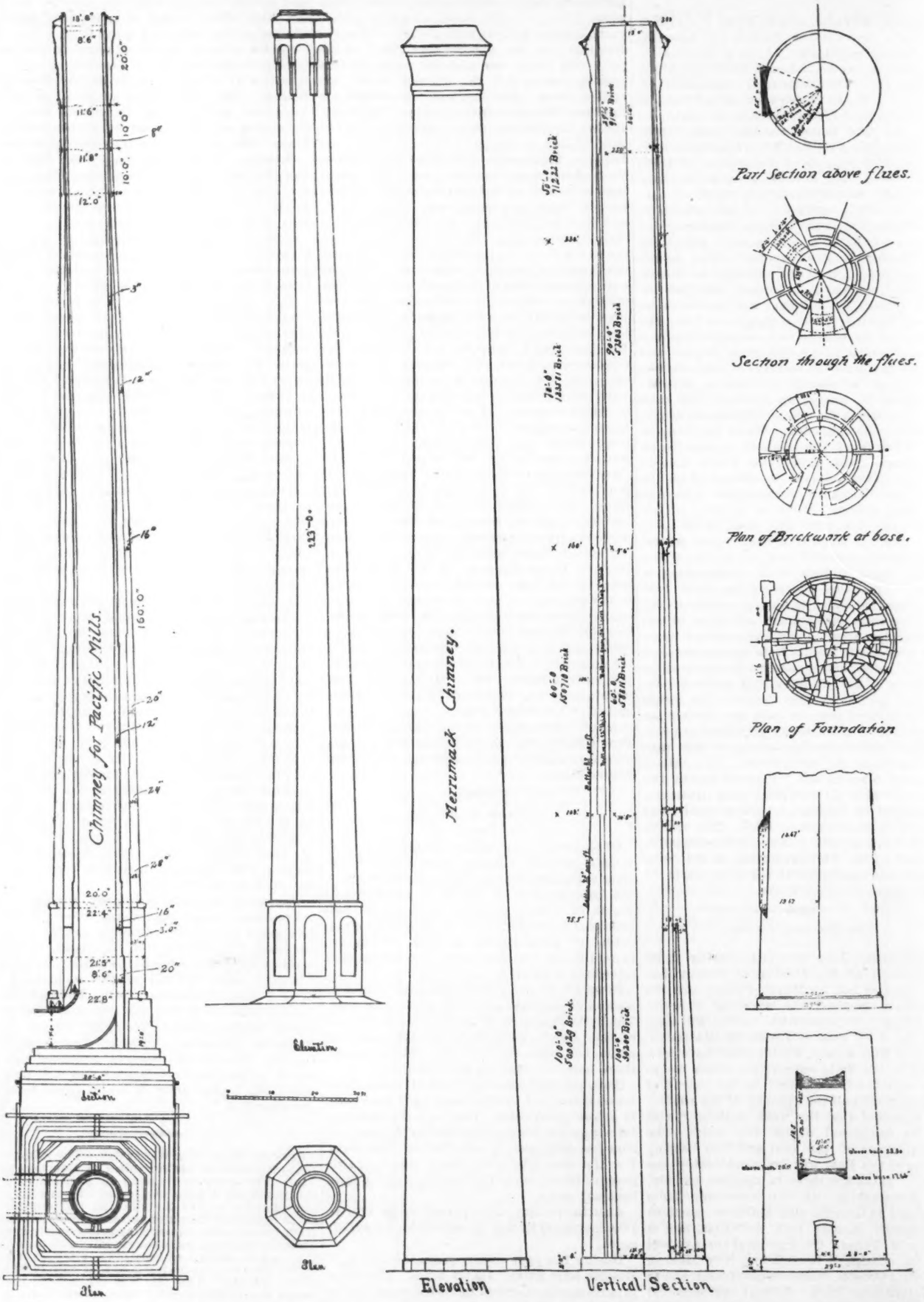
Some years ago the occupation of Algeria brought to the French nation nearly 7,000,000 acres of really valuable forests, and two-thirds of these forests belong to the State.

This was an opportunity to restore the French forest material, and this opportunity still subsists notwithstanding the heavy losses suffered. There was a great deal to do in Algeria relatively to woodland, and such work ought to accompany the replanting of forests in France. The neighboring countries set the example; the German States, which, in the point of view of produce, are more directly in relation with France, and from which this country demands the greater part of the timber necessary to its industry, have numerous schools spread about the country, according to local wants. Zurich, Munich, Vienne, Honenheim, Aschaffenburg, Thurandt, Neustadt and Eberwald are the centers of so many zones, to which the proper teaching corresponds with the climate, soil and local requirements.

In these schools the students are numerous; the teaching has for its special object to show the means of rendering a forest valuable and the general management of woodland. Such matters are linked together, so that it is only when private woodlands produce sufficiently for daily local wants that the State can engage in the production of the more valuable kinds of wood. The number of students admitted at Neustadt and Eberwald has been, since the foundation of the school, fifty a year, not including foreigners. In the ancient school of Aschaffenburg, now annexed to the Munich University, the number of native students was, on the average eighty-one, for a surface of 6,000,000 acres of woodland. During the space of twenty-eight years, Aschaffenburg has formed 2,583 students, including foreigners, one pupil for 124,000 acres.

Thurandt has had a yearly average of twenty-nine native pupils and twenty-three foreigners since 1810, although Saxony only possesses 1,167,413 acres of woodland, 396,999 acres of them belonging to the State. In Austria the school of higher studies on forestry, carried from Mariabrunn to the Vienna University, counted in 1881 343 students, mostly pupils coming from the secondary schools of Bohemia, Moravia, Southern Austria and Galicia. The faculty corps is, moreover, seconded by men properly drilled and well prepared, the organization of which dates from the year 1750.

SINKING PILES BY A WATER JET.—The following is the mode of sinking piles at Southport, Fla.: The piles are placed in position, and the nozzle of a hose connected with a pump placed at the foot of the pile. As the pump is set in operation the water and sand are pumped from beneath the pile causing it to settle to the desired position. As to the rapidity with which they can be driven by pumping, Capt. Jarvis timed the men in sinking a 30-foot pile 12 feet in the ground. The pile was taken from the barge, a rope tied to it by which it was hoisted by a derrick and lowered to its proper position, and then pumped down the required depth in six and one-quarter minutes. The actual time consumed in pumping the pile down 12 feet after it was placed in position, was one and three-quarter minutes.



FIGS. 1 AND 2.—CHIMNEYS OF THE PACIFIC MILL, AT LAWRENCE AND OF THE MERRIMACK CO. AT LOWELL, MASS.

CHIMNEY CONSTRUCTION.*

The Pacific Mills Chimney at Lawrence, Mass., U. S. A.

BY HIRAM F. MILLS, C. E.

The Pacific Mills chimney designed by me and built under my direction by Capt. B. F. Chadbourne in 1873-4 consists (see Fig. 1,) of an outside octagonal shell 222 feet high above ground, with a distinct interior shell or core 8 feet 6 inches in diameter inside, extending 1 foot above the top of the outer shell, and 11 feet below the surface of the ground.

The whole is founded at a depth of 19 feet below the surface of the ground upon a bed of clean, sharp, coarse, mortar sand 35 feet square, which is inclosed by a tight sheet of pine plank piling 3 inches thick, driven 5 feet, and standing one and one-half feet above the bed. This bed of sand is covered with a bed of concrete 1 foot thick, and upon this rests the pyramidal foundation of large stones of amorphous granite laid in cement mortar, in irregular layers, having the top of each roughly leveled by pointing off the bunches. This mass of stone work, 35 feet square at the base, is 7 feet high and 29 feet square at the top, at the level of the bottom of the flue. The brick flue walls are surrounded on three sides by stone walls 6 feet thick, having outside corners clipped for the height of 5 feet, and with walls 5 feet thick for the remaining height of 6 feet,

Upon this stone work and upon two cast-iron girders spanning the flue space resting upon this stone work rises the outer shell of the chimney, octagonal in form, the base stone, 20 inches high, being placed 22 feet 8 inches from outside to outside, above which is paneled brick work 3 feet thick, with vertical sides 18 feet 6 inches high and 21 feet 8 inches from face to face, surrounded by a belt of granite 16 inches thick and 22 feet 4 inches across from side to side. Upon this, with a width of 20 feet, begins the battering shaft, which, with a straight batter for 160 feet, draws in to a width of 12 feet. The batter then changes, and in a height of 10 feet the width becomes 11 feet 8 inches, and in 10 feet more it becomes 11 feet 6 inches, above which the walls are vertical, with the projections at the corners shown in the elevation. These projections, joining by arches, produce a width of 12 feet 8 inches, above which the head enlarges to a width of 13 feet 8 inches, having vertical sides 3 feet 6 inches high.

The walls of the head are 21 inches thick, decreasing at the arches to 8 inches, which continues to 40 feet below the top; then for 60 feet the thickness is 12 inches; for 40 feet it is 16 inches; for 20 feet it is 20 inches; for 18 feet it is 24 inches, and for 12 feet, or down to the granite belt, it is 28 inches.

Within the outer shell and built up with it are four inside buttresses, 2 feet thick for a height of 27 feet above the bottom of the flue, and 1 foot thick for their remaining height of 154 feet. The inside face of the buttresses was built 1 inch from the outside of the flue wall. The head of the outer shell is covered with 16 cast-iron plates ¾ inch thick, held in place by flanges and by 64 copper bolts 2 feet 6 inches to 2 feet 10 inches long and ¾ inch diameter.

The horizontal flue entering the chimney is 7 feet 6 inches wide, and 7 feet 6 inches high inside. Its walls are 16 inches thick for a height of 5 feet, above which they are 12 inches thick. It is covered by cast-iron girders 2 feet 7 inches apart, between which are small girders running lengthwise of the flue, far enough apart to receive one length of bricks, with their ends resting upon the flange at the bottom.

Upon passing through the outer shell the walls of the flue thicken to 2 feet, and support a cast-iron girder, upon which rests nearly one-third of the circumference of the vertical flue.

This girder is kept back from the inside of the flue, that the gases may not come in contact with it. As the flue bends upward the section is enlarged, and the top, covered with cross girders about 9 inches apart, curves with a radius of 5 feet. The bottom of the flue also bends upward, having a radius of curvature of 9 feet 9 inches.

The vertical flue is a cylinder 8 feet 6 inches in diameter inside, and 234 feet high, having walls of the following thickness and height:

20	inches	thick,	20	feet	high.
16	"	"	17	"	"
12	"	"	52	"	"
8	"	"	145	"	"

Six inches below the top of the flue wall was placed a cast-iron disc, covering 7 inches of the thickness of the wall, and projecting outward 8 inches, covering the space between the core and the outer shell, and upon this the wall was topped out with eight pieces of fire-brick, about 3 feet 7 inches long, 8 inches wide and 6 inches deep, held in place by copper bolts set in the wall.

The foundation stones were laid in mortar, made of one part Rosendale cement and two parts of sand.

The outer shell was laid in mortar, made of one cask of cement, two casks of lime, and six casks of sand up to the bottom of the 8-inch wall; then with one cask of cement, one cask of lime, and four casks of sand up to the projections, above which the cement was increased to equal in volume the lime paste.

The mortar for the flue walls was made throughout of one cask of lime and two casks of sand.

The stone foundation was laid between September 16th and October 16, 1873. The brick-work was continued from October 17th till December 5th, when the outer shell was 50 feet above the ground, and the flue carried on to 90 feet above the ground, that it might be used for a part of the boilers.

On March 7, 1874, boilers, having 452 square feet of grate surface, burning anthracite coal, were connected with the chimney in this condition, with satisfactory results. This use was continued till June 15th.

On June 5th, began to build up brick-work of outer shell, having taken down 5 feet of that built in the winter. On June 22, 1874, began to build up the core from height of 79 feet above the ground, having taken down 11 feet in height of that built in the winter. On September 15th, 1874, finished building the chimney, and began to take the staging down.

All work of construction above ground was from an outside staging.

The approximate weight of the chimney is 2,250 tons,[1] of which the stone work weighs 817 tons; the outer shell, with buttresses, 1,088 tons and the inner shell 345 tons. The number of bricks used was about 550,000.

The chimney is opposite the middle of a line of twenty-eight boilers, and 210 feet distant from them. Of this length 130 feet consists of two flues 7 feet wide and 4 feet high inside, running into one flue 80 feet long and 7 feet 6 inches square, which enters the chimney. The bottom of the flue at the chimney is about level with the grates.

This chimney was designed to serve for boilers having 700 square feet of grate surface, burning about 13 pounds of anthracite coal per square foot of grate surface per hour.

This chimney was struck by lightning on the 28th of June, 1880, fifty-two minutes after noon, when the fires were burning as usual.

Upon making repairs a lightning rod was put up, which consists of a seamless copper tube $1\frac{5}{16}$ inches outside diameter and 1 inch inside diameter, in lengths of 15 feet. The ends were squared and a thread cut in a lathe for 1½ inches. The couplings were 4 inches long, with 3 inches of thread in the interior and ½ inch in length at each end, plain, and tightly fitting the oustide of the pipe. In putting up care was taken to have the ends of the pipe firmly in contact.

At the top are seven points from a ball 4 inches in diameter, the central point being two feet long, the others one foot long. The top of the central point is 8 feet 6 inches above the iron cap which the pipe goes through. Inside of the upper pipe, and extending about 5 feet above the iron cap, is a

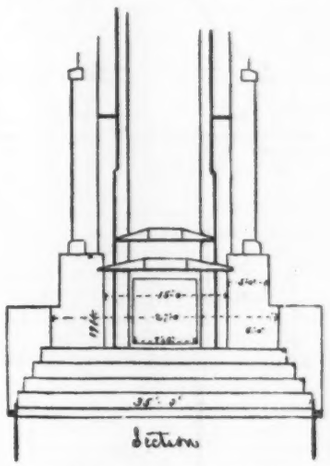


FIG. 1a.—SECTION OF BASE OF PACIFIC MILL CHIMNEY

1-inch iron rod, 8 feet long, to stiffen the projecting pipe. The pipe is buried in brick-work for 3 feet through the head of the chimney, and is elsewhere held by brass castings ¾-inch thick, 4-inches wide, projecting out 2-inches, and running back and hooking down over the back side of a brick ¼-inch, being there 2-inches wide and ½-inch thick. These were set in the middle of each pipe and below each coupling. One expansion joint was put in at mid-height.

At the bottom, the pipe, filled with a copper plug, was screwed 2 inches into a copper cylinder 4 inches long and about 4 inches in diameter, which was screwed into a 4 inch cast-iron pipe ⅝ inch thick, which stood out of ground about 5 inches, and extended vertically below about 5 feet, and then inclined, extended 60 feet, entering the canal about 7 feet below the surface of the water.

The Merrimac Manufacturing Company's Chimney, at Lowell, Mass.

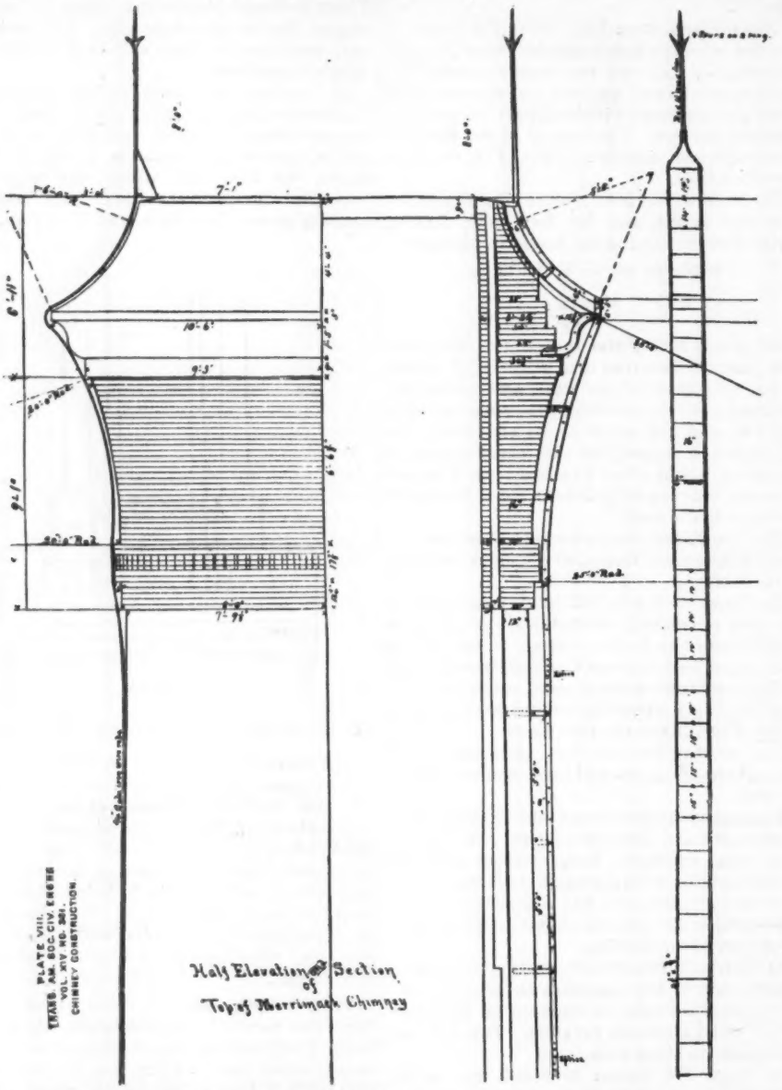
DESIGNED BY J. T. BAKER, C. E.

The Merrimac Manufacturing Company's chimney, built by Staples Bros., under the direction of J. T. Baker, between May 22d and October 23d, 1882 (see Figures 2 and 3), is founded on a ledge of quartzose sandstone. The top of the ledge on the north west side of the chimney is 4 feet below the surface of the ground, and about 10 feet below the surface on the southeast side. The top of the ledge was roughly broken off to bring it, by stepping, to approximately horizontal beds; it was then leveled up to the highest point with stone, laid in Portland cement, without sand. The sub-foundation was then built, 30 feet in diameter, to a height of 3 inches above the ground, with large granite blockstone, laid rough as it came from the quarry, having parallel and exceptionally straight beds and builds. On this was set the underpinning of granite, 2 feet 6 inches rise and 18 inches wide, having a wash 6 inches wide cut on the top. The underpinning was in 18 pieces, forming in plan a regular polygon of 18 sides, 29 feet across: inside of, and up to the top of the underpinning is filled in with large granite blockstone, similar to those in the lower part of the foundation. The underpinning is set in clear

*From the Transactions of the American Society of Civil Engineers, April, 1885.

[1]Gross tons, of 2,240 pounds avoirdupois.

FIG. 3.—HALF ELEVATION AND SECTION OF THE TOP OF MERRIMACK CHIMNEY.


Half Elevation & Section of Top of Merrimack Chimney
PLATE VIII. TRANS. AM. SOC. CIV. ENGRS. VOL. XIV. NO. 281. CHIMNEY CONSTRUCTION

Portland cement; the remainder of the foundation (above the leveling up) is laid in mortar made of Newark cement and sand, in equal parts by measure. The foundation was commenced on May 22d and finished June 17th. At the top of the underpinning the brick-work starts, consisting of 3 cylinders; the outside one, 28 feet in diameter outside and 24 inches thick, and the middle one, 18 feet in diameter and 8 inches thick, being tied by radial walls, with buttresses inside the middle cylinder, separated from the core by a 1 inch space. The buttresses are 12 inches thick for 130 feet in height, and 8 inches thick for the remaining height of 150 feet. The inside cylinder or core is 12 feet inside diameter and 16 inches thick. On one side of the chimney is a door and arched passageway, 4 feet wide and 7 feet 6 inches high, the bottom being at the top of the underpinning, giving access to the chimney flue. The middle cylinder is carried up vertically to a height of 75 feet 6 inches. The outside ring, battering $\frac{43}{100}$ of an inch per foot to a height of 100 feet, reduces the space between the two to 4½ inches at the height of 75½ feet above the underpinning, where the space is headed over, binding the two cylinders into one 36½ inches thick, reducing to 26½ inches thick at the 100 foot elevation, where the batter changes to $\frac{39}{100}$ of an inch per foot. For a further height of 60 feet the wall is 20 inches thick; for 70 feet additional the wall is 16 inches thick, and for a further height of 34 feet, to the enlargement for the head, the thickness is 12 inches. At the commencement of the head the wall is set off with a 3 inch projection on the outside and 1 inch on the inside, making a 16 inch wall for a height of 12½ inches, then a further set off of 3 inches for a height of 17½ inches, then stepped in three inches above which the brick work is stepped out, forming a curve with a radius of 20 feet for a height of 6 feet 6⅜ inches, where the iron cap commences. The height of the cap is 6 feet 11 inches and ⅝ of an inch in thickness, covering the top, and returning down 9 inches on the inside of the flue. The cap is built up in sections and is bolted together, the flanges being built into the wall, which is built up to the top inside the cap, the core being stopped 6 inches below the cap to allow it to expand freely. The core is uniformly 12 feet inside diameter to the top, the first 100 feet in height being 16 inches thick; for a further height of 60 feet, 12 inches thick; for 90 feet more, 8 inches thick, and for the last 29½ feet, 4 inches thick; it is entirely separate from the outside, excepting about the doorway and openings for the flues. At a height of 23½ feet above the underpinning are two openings, 12 feet high and 5 feet wide (arched top and bottom), for the admission of the wrought-iron flues, the center lines in horizontal plane forming an angle of 135 degrees.

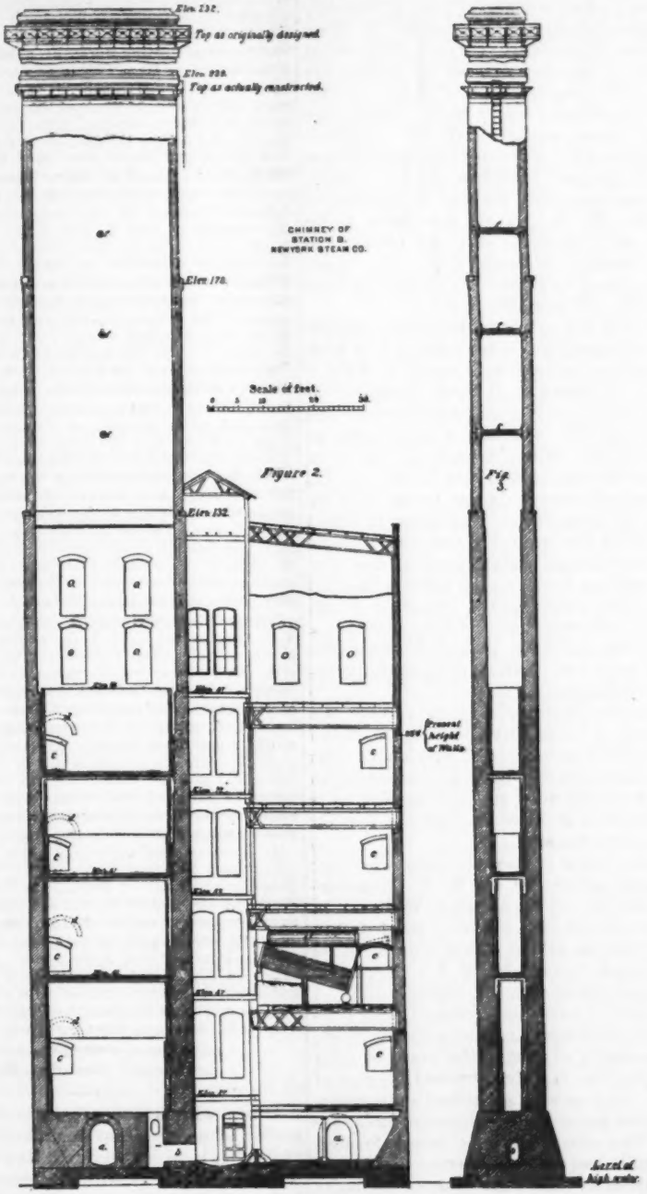
The foundation was	commenced	May	22d,	1882.
" "	finished	June	17th.	
" brickwork	commenced	"	24th.	
" "	up 100 feet	August	5th.	
" "	" 200 "	"	25th.	
" "	" 270 "	Sep.	13, ready for cap.	
" "	finished	October	23d,	1882.

There was a delay of from three to four weeks, caused by the cap not being ready; the outside staging was all down before the brick work was finished, the finishing being done from the inside staging. There were but two and one-half stormy days from the time the brick-work was commenced until it was finished, and two of these occurred while waiting for the cap.

The sub-foundation contains 6875 cubic feet; weight =	1,031,250	pounds
The shaft (including core, 255,458 bricks) contains 1,101,000 bricks; weight	5,734,375	"
The cap weighs	18,600	"
Total	6,784,225	"

or 3 392 tons 2 cwt. The brick were ordinary hard-burnt, of a dark red color, and common size and shape, being about 8 in.×4 in.×2½ inches. The core was laid in mortar made of one cask of lime to about five casks of sand, the outside shell in mortar made of one cask of lime, one of cement, and eight or nine casks of sand. The sand was not measured, but enough was added so that the mortar would just slip clean from the hoe and trowel when being worked. On the southeast side of the chimney is a ladder extending from the ground to the top of the chimney, where the sides are drawn in and a rod of iron 1¼ inches in diameter fastened between them, which is surmounted by a copper ring having four spurs, the rod which passes through the ring forming a central point, and extending 8 feet above the top of the cap. All the points are polished and tinned, and with the ladder form a lightning conductor. The sides of the ladder at the bottom was drawn in, and a 1½ inch×⅝ inches is fastened between them, one end of the rod being bent so as to be in contact for a length of about 6 feet with a 16-inch water pipe, the faces in contact being polished, and the connection made by soldering the rod firmly to the pipe. The sides of the ladder are of 2½ inches×⅜-inch wrought-iron, the joints being secured by a splicing piece of the same size as the sides, and 14 inches long; the surfaces in contact being polished, and bolted and soldered together, making a continuous connection between the tips and the water pipe. The sides are fastened to the chimney by being bolted to pieces of 2½ inch×⅜-inches iron at intervals of 5 feet, projecting from the chimney 10 inches, and built into the brick-work about 12 inches; the rounds are ¾ of an inch in diameter, 16 inches long, and 15 inches between centers. There is also on the opposite side from the ladder a ¾-inch galvanized iron wire rope, tipped like the ladder (both being connected with the cap), and at the lower end the wires are untwisted for a length of 4 feet, spread and soldered to the 16-inch water pipe to which the ladder is connected. The base of the chimney is in the boiler house, about midway of its length. There are two flues of wrought-iron entering the chimney, one from the southerly side being 5 feet by 6 feet, taking the gases from six sets of boilers. Each set is connected with the main flue by a flue 1 foot by 6 feet, the main flue being 1 foot by six feet, where the first branch flue joins it, and increasing in size by 6 square feet for each set connected with it. The other main flue is 5 feet by 11 feet where it enters the chimney, being designed to take the gases for 9 sets of boilers, though but 6 sets are now connected. The iron flues run through to the inside of the core, the bottom being curved upward with a curve, the radius of which is 10½ feet. The boilers are vertical, in sets or nests consisting of a central one 4 feet in diameter, and 24 feet long, with six others arranged around it in a circle, each of the six being 14 feet long and 42 inches in diameter. Each has 61 tubes of 2 inches diameter. The boilers are rated as 300 horse-power per set. Each set has 103½ square feet of grate surface, making for the 12 sets now in place a total of 1,439 square feet of grate surface, burning 10 to 12 pounds of bituminous coal per square foot per hour. The bottom of

FIG. 4.—STATION B CHIMNEY OF THE NEW YORK STEAM CO.; SECTIONAL ELEVATION.



the chimney flue is 9 inches above the top of the grates.

Details of the Merrimack Chimney.

Description of chimney	Round.
Lightning conductors	¾ inch galvanized iron wire rope and ladder, both copper tipped.
Cost of Conductors in place	$200.
Total height, including foundation	289¾ feet.
Height from ground line to top	282¾ "
Outside measurement at ground	30 "
Inside " " "	Solid.
Outside " " foundation	28 feet.
Inside measurement at foundation	12 feet.
Outside measurement at top (under head)	15 feet 6¼ inches.
Inside measurement at top	13 "
Average diminution of shaft from ground line	1/16 of an inch per foot.
Proportion of diameter to height	One-tenth (1/10).
Weight	3,392 tons 2 cwt.
Number of bricks used	1,101,000.
Stone masonry	6,875 cubic feet.
Cast iron cap	18,600 pounds.
Scaffold used	Both inside and outside.
Cost of scaffold	Not known; about $420
Cost of chimney complete	$18,50[illegible].
For whom constructed	Merrimack Mfg. Company, Lowell, Mass.
When built	Between May 22d and October 23d, 1882.
Time occupied in building	5 months.
Engineer	J. T. Baker.
Builders	Staples Brothers.
Nature of foundation	Sandstone ledge.
Number of flues from boilers	Two.
Horse-power of boilers	3,600.
Kind and shape of brick	Ordinary brick, hard burned, 8" long, 4" wide and 2¼" thick.

The Station B Chimney of the New York Steam Co.

BY CHAS. E. EMERY, M. AM. SOC. C. E.

In connection with the plans of the Merrimack and Pacific Mills chimneys, I, at the request of the secretary, present a brief description of the chimney, and incidentally of the boiler station of the New York Steam Company, constructed under my direction at "Station B" of that company, in Greenwich street, between Cortlandt and Dey streets, New York.

This chimney may be called a "creature of circumstances," from the fact that it was necessary to erect boilers of sixteen thousand horse-power on an irregularly shaped plot 75 feet in width and on the average less than 120 feet deep, and the chimneys were necessarily shaped to suit the space available. To obtain proper floor room the boilers were arranged in four tiers, each tier in a separate story 20 feet high, besides which the plans provide for a fifth story for coal storage and a basement for miscellaneous uses. Each floor is arranged for sixteen boilers of 250 horse-power each, which are placed in two rows to face a central fire room. There are two chimneys, one located between the boilers on each side of the fire room as near the center of the building as the shape of the plot permitted.

Figure 5 is a plan view of one story of the building and includes a horizontal section at a lower elevation through the vault under the sidewalk on Greenwich street; *A A* are the chimneys; *B B* the elevators; *Y Y* vertical steam drums; *D D* steam pipes to street; *E E* bases of columns of the elevated railroad in street; *F F* is the fire room, and *G* a circular staircase. The locations of boiler are numbered from 1 to 16. At the left are shown the floor beams in position, and on the right the side walls and steam drums, *C C*, of some of the boilers are represented.

Figure 4 shows a vertical transverse section of the building, with a boiler in position on one floor, and also a transverse vertical section of one chimney.

Figure 3, on the same plate, shows a longitudinal section of the same chimney.

The whole capacity of the building not being needed at first, the walls were only carried up to an elevation of 88 feet 8 inches, and a temporary roof applied, so that at present there are available only three stories for boilers and one above for coal storage. The south chimney has been practically completed. The north one is extended through the temporary roof and covered, but is connected with the other by a sheet-iron casing at the level of the openings, *O O*. There are now in place thirty-five boilers, aggregating 8,750 horse-power.

Customers were first supplied with steam in April, 1882, since which time the steam pressure has been maintained continuously day and night. The coal is brought rom the dock in carts and wagons and dumped from the rear street into small cars in the basement of the

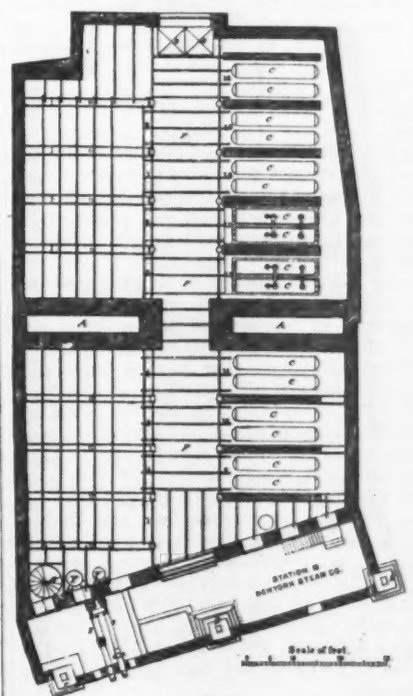


FIG. 5.—STATION B CHIMNEY, NEW YORK STEAM COMPANY'S PLAN.

rear buildings. These cars are run back to the elevators, lifted to the top of the main building, run out on tracks over coal bins and dumped, the coal descending by gravity through chutes in front of each alternate column and flowing out as needed on the several fire room floors close alongside the fronts of the boilers. The ashes pass from the ash pans down chutes in front of intermediate columns to cars in the basement. These cars are hoisted on the elevator to the roof of the rear building, run out on tracks to front of that building, and the ashes dumped into a chute, from which they are loaded into carts on the street below.

The boilers are of the sectional type, manufactured by the Babcock & Wilcox Company.

From lack of room, a well-established rule was necessarily disregarded, and the lower portions of the chimneys, instead of being independent, were made part of the building; the section of each being rectangular and corresponding closely to the floor space occupied by one of the boilers. Within the building the outside of the chimney walls are vertical; the offsets, due to reducing the thickness of walls upward, being inside the flue. Above the roof the inside of flue is parallel, and the walls are decreased on the outside, each offset being marked by a belt of granite blocks, forming a water table. The lining extends only to the roof line, and is put in in sections, supported on the internal offsets. The lower part of each chimney, above the footings, is 32 feet long outside, and 13 feet wide. The flue at the top is 27 feet 10 inches long and 8 feet 4 inches wide. The south chimney is topped out at a height of 220 feet above high water, or 221 feet above its foundation. The top of the chimney is, therefore, 201 feet above the grates of the lower tier of boilers, but only 141 feet above the grates of the upper tier of boilers.

The foundations of the walls of the building are at the elevation of mean high water, and the chimney and column foundations 1 foot below. The foundations are of concrete, laid directly on the sand of the old beach, which formerly extended to this point. The sand was, for the greater part, quite fine, but there were pockets of sharp gravel containing, at some points, small stone. The foundations were below the spring line, and the sand, being thoroughly saturated with water would flow when disturbed or undermined. The walls of most of the buildings in the vicinity were laid on longitudinal timbers, located at or near the line of high water, and showed no cracks or signs of settlement. The chimney and boiler house were, however, to be exceptionally heavy; so it was thought desirable, before beginning work, to test the bearing power of the sand, preliminary to which a test pit was sunk until the water became troublesome, when an iron tube was started down with a view of detecting any covered mud or other want of homogeneity due to the shifting of the river bank. All preliminary work was, however, promptly stopped by the management; the statement of possible difficulties being considered valueless as against the opinion of builders and others that a good foundation could be obtained without piling at that location. The bases of the foundations could not spread so as to reduce the pressure on the sand below 4 tons per square foot for the finished structure; and, before one-third of this pressure was reached, it became evident that the wet sand was comprehensible, and limited settlements took place which were not entirely uniform, as the chimney foundation received its full load before that caused by the boilers was received on the foundations of columns and walls. Eventually some narrow vertical cracks appeared, which relieved the strains, apparently without any material injury to the structure.

The concrete foundation under the walls of building is 9 feet wide and 2 to 4 feet thick; under the chimney, 22 feet wide and 4 feet thick, and under the two rows of columns, 18½ feet wide and 3 feet thick. The two chimney foundations are joined by a brick invert. Concrete at the elevation of that under the side walls was first extended over the entire area of the building, and an additional layer, 1 foot thick, applied afterward, the surface of which forms the basement floor. The walls are racked out at the bases to a width of 8 feet. The enlarged base of chimney is 20 feet wide. The walls of chimney, just above the footings, are 3 feet thick at the rear, 3 feet 8 inches on the sides, and 5 feet on the front (toward the other chimney.) The walls decrease, as shown on plan, to 20 inches thick at the top of chimney. An archway, *A*, is provided through the base of each chimney, as a means of communication between different parts of the basement. The opening *B*, is provided to clean the interior of chimney. On each floor and at each side of chimney, at rear of boilers, are provided the openings, *C C C C*, shaped to connect the horizontal flues from boilers, the openings being strengthened by complete blind arches, *d d d d*, above the partial arches at tops of the flue openings. The openings, *O O O O*, are designed for the application of economizers in the future, the gases to be brought out of the lower ones and returned to chimney through the upper ones. The upper part of chimney is stayed at *f f f* by iron rods passing through struts of pipe.

A fixed iron ladder is attached to the interior face of chimney, and connected at top with points and at bottom with cable to form a lightning protector. It was designed to make the top of the chimney with a projecting platform and iron reticulated balustrade, as shown by design at upper part of Fig. 4., in which case the chimney would have been 232 feet above high water. It was hoped that by painting the balustrade prominently it would give the effect of a capital to the shaft without the weight of actual surface projections. For various reasons, however, the top was finished with a granite coping at the elevation of 220 feet above high water, as previously stated; a simple footboard being provided about the chimney, as shown, with an iron handrail secured in coping stones.

Although the chimney appears slender the narrow way, it is supported by the walls to the elevation of opening, *O O*, and above that point it is calculated to have ample weight to resist the overturning moment caused by a wind pressure of 50 pounds per square foot on the area of one flat side.

The writer takes pleasure in acknowledging the valuable services of Mr. H. W. Brinckerhoff, M. Am. Soc. C. E., Assistant Engineer in immediate charge of the work during design and construction, and at a later date of those of Mr. Thos. E. Brown, Jr., M. Am. Soc. C. E., who was associated with Mr. Brinckerhoff.

These designs have accomplished their purpose for the particular conditions encountered; but the necessity of putting the plant on such limited space has largely increased the cost of the work, and caused continual embarrassments in the details of the internal arrangements. The other stations being located where land is less valuable, larger plots have been obtained and different designs throughout can be employed.

How to Drain London and its Suburban Valleys.

The plan for the drainage of the Lower Thames Valley proposed by Mr. Bailey-Denton, of the firm of Bailey-Denton, Son, & North, for the drainage of both the Lower Thames Valley and the Lower Lea Valley, as well as the disposal of the sewage of the Metropolis, is as follows:

He would deal with the sewage of both the suburban valleys by intermittent filtration through "natural soil." Having concentrated the sewage of the Lower Thames Valley at Ham Fields, he proposes to lift it to the summit of Kingston Hill, whence it would flow by gravitation along the Portsmouth Road, down to land in the neighborhood of Woking. As is well known, there exists on the Bagshot sands plenty of porous and profitless land, suitable for filtration, which can be cheaply purchased. This land is not only capable of purifying a very large quantity of dirty liquid, but it may be turned to profit by the application of sewage to its surface and the production of vegetation. Moreover, these would not be the only advantages secured, for the effluent water, after filtration through the soil—amounting to from 10,000,000 to 15,000,000 gallons daily—would be conveyed in a pure condition back to the Thames by its tributary the Mole, which joins the former at Molesey, below the intakes of the water companies, but above Teddington Weir—a desideratum which will be recognized as of the greatest consequence by all who have studied the economy of the Thames in relation to the metropolis and the sanitary condition of the river.

With regard to the Lower Lea Valley where most of the districts have adopted some method of sewage treatment without practically relieving the River Lea of pollution, Mr. Bailey-Denton proposes to intercept the dirty liquid from each individual district, after the coarser floating materials have been separated from it at the several existing works, by a main intercepting sewer extending from Barking up to Waltham, to be constructed of a size capable, by further extension upward of receiving the whole of the sewage of the valley as far as Hertford, together with that which may be brought into it from the districts of Friern Barnet and East Barnet, and which may swell the whole to upwards of 20,000,000 gallons daily. Having brought this collected sewage to the marshes below Barking, Mr. Denton proposes to lift it to land some 30 or 40 feet above sea level. This is part of the land which the Royal Commission referred to pointed out, on the evidence of Mr. Whittaker, as suitable for intermittent filtration—and which, existing as it does within a short distance of the northern outfall, might be used for the sewage of the metropolis, and the effluent liquid conducted with advantage back to the river not far from the junction of the Lea and the Thames.

Mr. Denton's proposal for dealing with the sewage of the metropolis is to continue the present outfalls from Barking and Crossness to Canvey Island on the north side, and Cliffe Marshes on the south side, of the Thames, where it is proposed to separate the heavy mineral from the lighter flocculent matter, and use the former for warping and raising the land, and the latter for conversion into manure, if saleable, or, failing profitable conversion, to burn it out of the way. The effluent, clarified by the separation thus effected would then pass through extensive osier-beds before reaching the estuary. This mode of treatment would render all chemical precipitation nearer the metropolis unnecessary, and would save money and avoid nuisance.

Canvey Island having been selected by Col. Jones, V. C., and Colonel Hope, V. C., besides Mr. Denton, it may be assumed that its suitability for the purpose in view has received ample consideration. Mr. Denton lays great stress on the absence of residential property on the island, and on the fact that, if it should be deemed advantageous to bring the sewage from the southern part of the metropolis across the river to the north, in order that the whole may be treated together, the island is large enough for the treatment of the sewage of both sides, while its position would favor the employment of convict labor in the preparation of the ground, as suggested by Colonel Jones.

Mr. Denton considers that the Lower Thames Valley sewage may be satisfactorily treated in the way proposed by an outlay of 300,000*l.*, involving an annual charge for fifty years of 13,400*l.*, equivalent to a rate of 4¼*d.* in the pound, and of the Lea Valley by an outlay of 352 000*l.*, involving an annual charge of 15,720*l.*, equivalent to a rate of 4¾*d.* in the pound. Estimating the outlay in the case of the metropolis at 2,750,000*l.* the annual charge would be 122,833*l.*, with a rate of a small fraction over 1*d.* in the pound to repay the outlay with interest in fifty years.—*Sanitary World.*

"Weak" Business-Men.

Almost without exception the strong men of to-day who were never weak, had small beginnings. It is worth while to look closely into what it is that constitutes commercial weakness and detect if we can the first springs of the insolvencies which form so depressing a feature of every period of industrial readjustment.

The weak men are not necessarily those who begin with a small capital, but those men are almost invariably weak who attempt with hired capital, hired merchandise, hired stores, and hired dwellings to leap into a high place in the whirlpool of our modern fierce competitive wholesale business. During the wonderful expansion of the last generation there have been many very remarkable instances in manufactures, as well as in commerce and in banking, of wonderful progress from very small beginnings. It is in the effort to repeat these brilliant careers that a large proportion of the men who are now failing in every department of business have weakened themselves. They overlook two things. One is that the times have changed to some extent, and that the world's industry is no longer expanding in the same wonderful way as it did under the influence of the gold discoveries and the railroad system about completed in all civilized nations and the "boom" of railroad-building ended. Another thing they overlook is that the successful men of the last generation whom they desire to imitate did not start with the style, dash, and expansion

which young merchants nowadays seem to thing it necessary to put on in order to force their way to a high place in the business world with the suddenness of a sky-rocket.

What makes beginners weak nowadays is the enormous proportion of their expenses to their capital. They must have fine stores, which places on them the burden of devouring rent. They must hire most of their work done so that their personal dignity shall not be compromised by too much personal exertion. They must buy their goods on long credits and submit to a corresponding discrimination in the price. They have to live in a certain style in order to advertise their solvency and success, and belong to "clubs" and give wine dinners. These ventures are almost always made by several men as partners, and they must all live in equally good style and houses. Their wives watch each other jealously to see that no one is outstripped by any other, and almost insensibly a little competition between them springs up in their manner of living. If one of the wives drives a coupé one day the wife of another must drive a carriage the next day; if one goes shopping in expensive stores so must the others; if one buys costly things the others will want to spend a little more. The domestic pressure for funds makes itself felt by the drain on the money of the firm for the living expenses of the partners, each of whom finds year by year that to keep up appearances in business and in society he must draw a little more, and a little more, and use it all up.

This almost universal inflation of expenses in business and in living is the bane of our mercantile community. One of the meanings of the present depression is that this must be reformed altogether. There is too much style, too much system, too much organization, too much help, too large stores, too much credit, too heavy an interest account, too much rent for house and store, too little of the old-fashioned way of doing the utmost possible amount of the work without high-priced assistance, too little of the old-fashioned dread of borrowing, too little of the old-fashioned thrift, and above all too little at home of the old-fashioned disregard of the dictates of fashion. —*Chicago Tribune.*

Unprofitable Advertising.

Within the last few years it has become the fashion with some people to do their advertising in their own private way, instead of through the newspapers. Some distribute cards, some circulars, some pamphlets, some even almanacs, and some inconceivable monstrosities of oddity, circulating them by the hundreds of thousands through the mails. The printer's art has been taxed to the utmost to gratify the tastes of these advertisers. Some of the finest as well as some of the basest specimens of the art of engraving, of chromo-lithographing, and of color printing, are being produced for these purposes, and every conceivable style of fancy paper is brought into requisition.

The advertisers vie with each other in the elegance of their designs and the costliness of their devices, taking it for granted that the receivers will conform their estimate of the status of the advertiser to the artistic pretensions of his advertisement. Some people may regret that the noble art of printing, at the period of its highest achievement, should be subjected to such debasing use; but, to those who thus employ the art, it should be equally a matter of concern that the debasement so completely fails of the object for for which it is intended.

With him who notices such advertisements at all, the first feeling on receiving one of these superb specimens of typography or engraving is apt to be one of disgust that it relates to the artistic pursuits of his butcher or his bootmaker, or that the subjects of its elegant illustrations are chairs and tables, refrigerators and brooms; he throws it down with an indefinable grudge against the man who has been guilty of such a ridiculous prostitution of art, and, without exactly knowing it, he is distinctly convinced that a tradesman who spends so much money in such an incongruous way is not likely to be endowed with the common sense of a good man of business or to sell cheaply.

In truth, however, those who take any notice whatever of this flood of announcements form but a very small percentage of those who receive them. They have come to be the nuisance of both the parlor and the counting-room. At home they are never opened but with disappointment, because they come in the place of letters really hoped for. In the office the merchant finds his morning mail stuffed with these intrusions upon the serious affairs of his business, which he inwardly curses or impatiently consigns to his waste-paper heap. In short, if a public vote could be taken, it would unanimously declare these drumming missives to be an intolerable nuisance that should be denied the privilege of the mails.

Men of business who resort to this method of advertising can not be ignorant of the fact that the people whom they would reach have become nauseated with it. They must be aware that they themselves disregard all such appeals for patronage; and what reason have they to suppose that others receive their applications with more patience. Sagacious advertisers are beginning to see this and are returning to the old method of public announcement. The newspaper is, in every sense, the best medium for advertising; and for a given result, it is by much the cheapest also. It reaches a far greater number of possible customers than private announcement can; and it is more certain to receive attention. The private circular is thrown aside as a thing which people have come to regard as a bore, and which is neglected because its recipients have no time to attend to it. The newspaper is used in each day's hour of leisure, and readers find interest in reading its advertisements as well as its news, because of the variety they present and the information they convey respecting a wide diversity of interests. It may be safely estimated that an announcement made through the press is noticed by fifty readers, where, made in a private way, it would reach but one. If, therefore, the same amount were expended in either case, the result would be fifty-fold better from the former method than from the latter. There are, undoubtedly, cases in which the circular is a better medium than the newspaper. Such, for instance, as where the matter is necessarily lengthy, and the cost of newspaper space would therefore be very large. But such cases are quite exceptional, and the sooner advertisers learn the folly of their present large expenditures in seeking publicity through private means the better for their pockets and their success.—New York *Commercial Advertiser.*

The Horseshoe Switch.

Mr. John B. Batt has perfected a new invention, known as the "horseshoe switch," the name being taken from the peculiar construction of the rail thrown by the lever. The rails are nearly continuous, and are built somewhat on the principle of the "split switch," the difference being that in the horseshoe switch the rails are all stationary. The inside stub of the left switch rail and the right side of the main rail are set at a sufficient distance from the other rails to give plenty of play for the flanges of the wheels. At the end of the switch, with the points facing the opening, is set a rail bent in the shape of a horseshoe, with the points facing the switch. This is thrown by a lever similar to that used on the old style switches, and is not used by the wheels except when the switch is thrown from the other track, and a train running in the opposite direction will pass over the rail and land safely on the main track. The switch has not the objection of many of the old style switches in that it is very simple, and combines the good points of these without there objections. The expense of making them is very slight, as the chairs, head-blocks and many other parts of the old style switches are done away with.—*Exchange.*

A Prussian Railway Corps.

A railway corps of the German Empire, says the *Army and Navy Quarterly*, consists of a Prussian regiment and a Bavarian company, the latter being precisely like a Prussian company in every respect. The Prussian railway regiment (*das eisenbahn* regiment) is organized in a regimental staff and two battalions of four companies each. A company in peace time consists of four officers, eighteen non-commissioned officers and 100 privates. The regiment is for excellent reasons, for all purposes of training, placed immediately under the general staff. It is only by being constantly in immediate contact with the best and most selected officers of the German army that the officers of the railway corps can be expected to know and learn what is required of them. They are thus able to know the slightest alteration taking place in German and foreign railway matters, as well as every change or inovation in foreign armies. They have, moreover, immediate access to men in in high authority, and can thus at once make known their ideas in quarters where they can take effect without delay. The material given to the Prussian railway regiment is very considerable, and is a striking contrast to the parsimony in the use and expenditures of stores generally practised in the German service, thus showing the great importance attached to the efficient training of this new branch of the army. The regiment in fact actually possesses and works by itself a line from Berlin to the artillery practice ground near Lutterbach, some thirty English miles long. It has been given in addition a large practice ground, with every facility for training recruits. Here the latter are taught laying sleepers, rails and telegraph wires, destroying and preparing lines and engines, in fact, every kind of railway work, and bridges have been built to train men in the repair of broken arches, etc., and destroyed railway works of every kind. The regiment has an ample supply of engines, passenger carriages-goods vans, trucks, etc. There is thus every facility for training men to act as porters or unskilled workmen in loading and unloading of warlike and other stores and teaching non-commissioned officers and artificers engine driving, the care and repair of engines, the duty of firemen, pointsmen, shunters, etc., and finally the duties of railway guards or the management of trains and regulation of traffic. The strength of the railway regiment, large as it is in peace, would be enormously increased were it mobilized for war. Before the Second battalion was raised Paris and Helldorf put the strength of the German railway corps, when mobilized for war at eight companies of artificers, four traffic companies and two companies of unskilled workmen (*bau-betriebs und arbeiter compagnien*). This has of course, been very much added to by the creation of the Second battalion in 1875, and we should not be much out if we reckoned on these numbers as now doubled, certainly as regards the traffic companies.

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THE 34th meeting of the American Association for the advancement of Science will be held at Ann Arbor, Michigan, from Aug. 26 to Sept. 1, 1885. The newly elected President, H. A. Newton of New Haven, Ct, will preside succeeding Prof. J. P. Lesley of Philadelphia, late President. No announcement of papers to be presented has yet been made, but we understand that there will be a movement to push forward Section D, or that devoted to Mechanical Sciences, more prominently than has been done heretofore. This section includes chiefly civil and mechanical engineering.

THE Philadelphia papers report the work on the B. & O. line through that city as fairly commenced with over 1000 men employed. The exact location of the bridge over the Schuylkill is yet undetermined but it is expected that that point will be settled within the week. In West Philadelphia the work is as yet confined to private property, no streets having been interfered with. On the East side of the river the men are at work in the meadows in building the extension to the Delaware River front.

Gen. Wm. Sooy Smith & Son are said to have secured the contract for putting in the foundations for the Schuylkill River Bridge, the pivot-pier calling for a depth below the water surface of 65 feet. The contract for the 1700 ft. tunnel near the Fairmount Basin will be given out shortly. It begins close to where the old Spring Garden Gasworks are located, south of Callowhill Street and opposite the end of Twenty-fifth Street. Taking a curve, it goes under Twenty-fifth, Spring Garden, Green, Hamilton and Brandywine Streets, Fairmount Avenue and Parrish Street, and comes out in an open cut just above Parrish Street.

Panama Canal Notes.

The *Bulletin du Canal Interoceanique*, for July 1st, says that the excavation on the line of the canal for April was 775,000 and for May 798,000 cubic metres. M. Dingler, the Director General of the Canal, is in France; 1,200 tons of material and stores were landed at Colon in the first fortnight of June; since June 15th there has been sent from Europe, 759 tons charcoal, 303 tons of bricks, 7,200 cases of compressed powder in cartridges, a total weight of 495,000 pounds, and 120 barrels of miners' fuse.

The Corinth Canal.

The *Bulletin du Canal de Corinthe*, for June 30th, contains the annual report of the Commissioners for 1884. According to this document the total sum expended to date of Dec. 31, 1884, is 9,600,496 francs. General Türr presented the following statement of the progress made since June 15, 1882:

	Cu. Metres.
From June 15, 1882 to the end of 1883 (18½ months)	352,000
In 1884 (12 months)	835,000
In 1885 (first 6 months)	720,000

According to this report the general excavation per month has increased from 19,000 to 120,000 cubic metres.

An average of 1,500 employes are engaged upon the canal, and all the work connected with the enterprise is reported well under way, including the breakwaters at Isthmia and Posidonia and the iron bridge, of 80m. (259.2 ft.) span across the canal at a height of 141 feet above the water surface, for the Piree-Peloponise Railway.

The report contains two lithographic views from photographs of April 20, 1885, showing the condition of the top or "English" cut.

The First Wire Suspension Bridge in the U. S.

According to Thompson Westcott, in his History of Philadelphia, 1884, the first wire suspension bridge in the United States, if not in the world, was thrown across the Schuylkill River near the Falls, in Philadelphia, in 1816.

Its history runs as follows: In 1809 Robert Kennedy and Conrad Carpenter, built a chain bridge at the Falls of Schuykill, which broke down in 1811. Josiah White and Erskine Hazard, afterwards famed as the early pioneers in the anthracite coal trade of Pennsylvania, had erected a rolling mill and a wire factory in this neighborhood, and after the collapse bought out the rights of Kennedy and his associates; a new company was then formed and another chain bridge constructed in April, 1811, but this bridge in turn gave way in 1816. White and Hazard then swung a wire suspension bridge across the river from an upper window of their factory to some large trees on the west bank, steps leading from the trees to the ground. This primitive bridge structure was intended for foot passengers only, and but eight persons were allowed upon the roadway at any one time. The bridge is said to have cost $125, and a toll of one cent was collected from each passenger, until the original outlay was returned, when the bridge became free. No details are now accessible showing the plan upon which it was built.

Mexican Railroads.

Bradstreet's, for July 11, contains an interesting sketch of the railway system in Mexico. It seems that President Santa Anna in 1855 laid the first ten miles of track on goverment account from the port of Vera Cruz to San Juan. In 1856 an American engineer was sent out from New York as chief engineer of a line from Vera Cruz to the City ot Mexico, but after two years work on the enterprise the frequent interruptions from the chronic revolutionary movement of that time caused the scheme to be abandoned.

In 1873 the Mexican Railway was opened to the public from the capital to Vera Cruz, a distance of 263 miles, with 30 miles of branches; this railway represents $55,000,000 of capital, or $190,000 per mile. No dividends were paid on the stock until 1882, when the transportation of material for the Mexican Central and National lines enabled 5 per cent. to be declared on the investment.

The chief permanent dependence for freight traffic on this line is upon the shipment of pulque, the cheap beverage of the country, a traffic now worth $400,000 annually to the company, this being in excess of the entire passenger earnings. Exports are insignificant in amount and when the imports ceased upon the completion or suspension of work upon the two railway enterprises mentioned, the earnings of the road fell from $3,000,000 in 1882 to less than one-sixth that sum in 1884.

As showing the effect upon this sole highway from the capital to the sea of the disbursments made by the interior railroads during construction, it is mentioned that for about two years nearly 70,000 names were carried on the rolls of the Mexican Central and National railways, and it is estimated that up to Jan. 1., 1884, American capitalists had expended $60,000,000 in the country.

In the second half of 1884, or after the lull in this import, the whole freight traffic on the Mexican Railway averaged only 100 tons daily in each direction. The Mexican Government recognizing the prime need of the republic in the way of railroads, in 1867, granted this line an annual subsidy of $560,000 for 25 years, or a total of $14,000,000 in bonds.

The next great demand of the country was met by the concession made to the Mexican Central R. R. for a road to the northward from the city of Mexico. This company built 1224 miles on its main line, 300 miles being really production to stock and bondholders. Under the terms of the original project there still remains to be built by this company, a branch from Aguas Calientes, a point on the main line 250 miles north of Mexico, to Tampico on the Gulf, a total distance of 500 miles. Of this line 100 miles is built from Tampico towards the interior. The company also intends to complete the connection between the two oceans by another branch of about 500 miles to San Blas on the Pacific; a bare beginning of 16 miles has been made at the coast. Since the beginning of this last line the policy of the company has changed, and it has been determined to commence at the main line and first connect with the city of Guadaljara, with its 100,000 inhabitants within 130 miles of Lagos.

The Mexican Government has agreed to pay the Central Company a subsidy of $15,295 per mile as fast as the designated sections are completed; and thus far the company has earned $16,250,000 of subsidy and has received about $6,000,000. This subsidy is paid by the government in certificates receivable as cash in payment of 8 per cent. of duties at all custom houses in the republic. The law makes it obligatory, under severe penalties, on individuals paying such duties to take these certificates at par for 8 per cent of their dues.

Bradstreet's says that with a people possessing a proper sense of commercial honor this law would have fully protected the railway company. But the Mexican government has found it convenient within the past month to suspend all further cash subsidies to railroad construction, and the blow is a severe one to the struggling companies, and more than that to future Mexican credit. Based upon confidence in the good faith of the Mexican government, the Central Company has incurred liabilities exceeding $100,000,000, an amount now practically sacrificed by this shameless exhibition of public immorality on the part of Mexican statesmen.

The Mexican National Railway Co., has been engaged contemporaneously with th

Central in the construction of a line from Mexico to Loredo, a distance of 820 miles, making an Eastern coast line connection with New York. A part of this road is built and running, and its President, General Palmer, has lately submitted to the present first mortgage bondholders a plan for completing the work. In this he asks them to surrender their prior lien on the road and consent to the issue of a new first mortgage of $10,000,000, the bonds to be offered in Mexico, where the general believes they will be taken if the present bondholders do not object.

Bradstreet's suggests that General Diaz may be shrewedly bearing the market in the interest of Mexicans, and thinks it is safe to say that foreigners have had enough of that country.

Of the 6,000 miles of railways in the republic only 700 miles have been built by native capital. Foreign corporations have been and are being continually harassed by all manner of interference in the management of their property and their working operations seriously embarassed; if dividends are to be earned, it must be in spite of obstacles continually presented by the unprincipled men who trade for the control of the country and its enterprises.

PERSONAL.

ALBION G. BRADSTREET, formerly Chief Engineer of the Tehuantepec R. R., is spoken of as the successor to Manager Robinson of the Mexican Central R. R. who is said to have resigned.

COL. EZRA MILLER, the inventor of the Miller coupler and buffer, died July 9 at his home in Mahwah, N. J., after an illness of several months. Ezra Miller was born in Bergen County, N. J., near Pleasant Valley, in 1812 His father intended that he should be a physician, but he finally became a civil engineer. He entered the New York militia in 1833, and was promoted through the various grades until, in 1842, he became Colonel of the Second Regiment. In 1848 Mr. Miller moved to Rock County, Wis., and engaged in surveying State lands. He was elected Justice of the Peace in the town of Magnolia, and served for two years. In 1851 Gov. Dewey, of Wisconsin, commissioned him Colonel of the Eighth Regiment of the Wisconsin militia, and he remained in command of that organization for a number of years. In 1852 he was elected a member of the State Senate, and served during one term, refusing a renomination.

Col. Miller's fame rests principally on his invention of the Miller car coupler and buffer. In 1853, while he was engaged in a survey of portions of the Northwestern Railway line there were a number of accidents on various railroads, in which loss of life was caused by the telescoping of cars. He became impressed with the necessity of preventing such occurrences, and after a number of years of study and work he produced the Miller coupler, buffer, and platform, which long since came into general use on all American railroads. His first patent was taken out in 1864. Of late Mr. Miller has resided in Mahwah, N. J,, where he was elected to the State Senate in 1883.

DR. RUFUS H. GILBERT, the projector of the elevated railroads, died in New York on July 10, in the fifty-third year of his age. Dr. Gilbert was born in Guilford, Chenango Co., N. Y., his father, Wm. Dwight Gilbert, being one of the associate judges of Steuben County. Young Gilbert was first apprentice to a druggist but soon abandoned that position to enter a large manufacturing establishment where he remained 6 years and became an expert mechanic. After serving his full time he began the study of medicine and graduated at the College of Physicians and Surgeons, in New York; he began practice as a physician in Corning, N. Y. He devoted himself to the improvement of hospital management and studied the subject in London and Paris. The question of cheap rapid transit first suggested itself to him as a means of thinning out the population and giving the poor a chance for fresh air and better quarters. On his return from Europe the Rebellion had broken out, and Dr. Gilbert entered the army as surgeon of the Duryea Zouaves; he performed much good service and held a number of important positions in the army medical staff. At the close of the war physical disability prevented him from resuming the practice of medicine, but he became Asst. Supt. of the Central R. R. of New Jersey, and by remodelling that road he earned for it a wide popularity among the traveling public. He was still interested in his rapid transit problem and finally gave up all his time to its consideration; he invented the elevated railway, and after much personal labor obtained a charter for a road through Sixth Avenue in this city. His patent covered an arch of iron springing from the curb on either side of the street and carrying tracks upon which local and through trains were to run independently; the arch was also to support the telegraph wires. Capitalists were afraid to put money into the scheme and it was some years before work was commenced. The Sixth Avenue line was finally opened to travel June 1, 1878, the first train having been run on May 1 from Trinity Church to 59th St. in 16 minutes. The name was changed from the Gilbert Elevated Road to the Metropolitan Transit Co., soon after it was opened on the ground that the latter name would better attract capital. Dr. Gilbert was at first chief inspecting engineer, but the company infringed upon his rights, law-suits followed and he was finally removed from his position and the matters at issue compromised by the payment to him of $100,000 in the company's stock, which since the last consolidation is not paying dividends. Dr. Gilbert died a comparatively poor man in accordance with the usual fate of inventors.

CORRESPONDENCE.

A Metric Catechism.

EDITOR ENGINEERING NEWS:—In Mr. North's letter to ENGINEERING NEWS, dated July 7th, why did he say that the words of a chemist were evidently quoted in a discussion at the Am. Soc. C. E. Convention? He wished to imply that otherwise the speaker would not naturally have used a metric expression.

Was he willing to imply that a chemist would naturally use metric expressions? Willing or unwilling, the fact is undeniable.

Was the adoption of the metric system by chemists throughout the United States brought about by a parcel of fools who squandered our country's money in forcing it upon them? Probably.

Might not the chemists have been seeking their own convenience? Impossible, if the metric system is correctly characterized as "a system of foreign measures" * * "whose only advantage lies in their extreme inconvenience to the person who has to manipulate it."

In what units do American engineers commonly express the relation of weight to bulk? In pounds per cubic foot.

How do American engineers express quantities of timber? In the so-called board measure mentioned by Mr. North.

How can any data per cubic foot be applied to quantities expressed in board measure? By division by 12, as, for instance, may be seen in the following passage from the Report on the Preservation of Timber, as given by abstract in the last number of ENGINEERING NEWS, it refers to the use of creosote. "To perfectly protect timber against the *teredo* it seems to be established that from 10 to 20 pounds per cubic foot is required, depending upon exposure. The total cost may be estimated therefore at 14 to 24 cents per cubic foot or $12 to $20 per 1000 feet B. M. etc." Here the 12 and 20 are obtained from the 14 and 24 by dividing by 12 and moving the decimal point.

What is the common measure of wood used for fuel by Mr. North's firemen? The cord.

How can any data or dimensions in feet or cubic feet be applied to cord measurement? By multiplication or division by 128, since there are 128 cubic feet in the cord.

Suppose that fire-wood and dimension timber had always been measured in nothing but cubic feet, would there have been any inconvenience therein? Computers might have suffered a loss of practice in dividing by 12 and multiplying by 128.

Suppose that firewood and dimension timber had always been measured in nothing but cubic meters, the cubic meter being the unit of bulk for general purposes also, would there have been any inconvenience therein? It makes little difference in computation whether the unit is the meter, the foot, or anything else; so long as it is the same for everything, you lose your multiplication and division.

Aside from affording practice in computation, what is the particular convenience to English-speaking people of the cord and the American board measure? The cord is so named, because it was originally measured by a cord or line; the magnitude it signifies is thus as clearly pictured to the English mind as when we say a thing is "about as big as a piece of chalk." If on the other hand the cube of the principal unit of length were taken as a measure, some mental grasp would be required to imagine the geometrical figure constructed.

The American board measure is so convenient to English ears that in England it is unknown or scarcely known. In the London market, timber is sold by what is called a *ton*, of about 1 cubic meter, but more commonly by the *load* of nearly 1½ cubic meters, also by the Petersburg standard hundred, so miscalled, meaning 120 pieces and amounting to somewhat less than 5 cubic meters, as well as by various other ingenious methods of reckoning.

Would it be an inconvenience to have engineers, who apply science, use the same system of measurement that scientific men and chemists do? If the metric system is otherwise desirable, its adoption by chemists and others need not prevent engineers from using it.

Are all chemists and scientific men stupid, and do all the bright men become engineers? Is that the reason why the former have adopted the metric system, while, according to Mr. North, "no American engineer thinks in metric terms," and the discussions at the Am. Soc. C. E. Convention were conducted mostly in old measures? Modesty forbids us to answer.

CRANK.

Are Engineering Schools Necessary?

PITTSTON, PA., JULY 9th, 1885.

EDITOR ENGINEERING NEWS:

Will you answer through your valuable paper the following queries? Do any of the technical colleges give such education in Engineering (practically) as will justify a man in calling himself an engineer at the end of four years study? Is it not much better for a young man of limited means to spend the four years required for a college course in learning the practice of engineering under some competent engineer, taking it for granted that the young man will apply himself diligently in leisure hours to obtaining the necessary theoretical knowledge and training?

Yours Truly,
"A READER."

[To your first question we answer decidedly No. The diploma issued to the graduate of an engineering school simply means that the student has successfully passed through a preliminary course of training especially intended to better fit him for actual study and practice in a certain profession. The man must graduate in the world's school of experience and test and prove his theory by much actual work done before he can be properly called an engineer.

The answer to your second question must depend on surrounding conditions and the mental capacity and perseverence of the would-be engineer. Many of our best and oldest engineers never graduated at an engineering school. But the profession has so far advanced and now covers so broad a field of knowledge, that the young man who starts without the preliminary study under competent teachers, to be obtained at our best technical schools, will find himself sorely handicapped in the race for prominence in the profession of civil engineering. If the young man has plenty of bodily and mental vigor, and can work all day and study half the night; and can find a thoroughly competent practicing engineer sufficiently self-sacrificing to guide him in his studies, he may advance rapidly; but he will find it up-hill work. Our advice is, go to a good engineering school if you can; if you cannot afford it, prepare for plenty of hard work if you would succeed.]

—ED. ENG. NEWS.

AN important work which Government officers may be called upon to perform soon is the location of a definite boundary line between Alaska and British Columbia. The discovery of gold in the Yukon district has attracted a large number of miners into that part of the world, and those who have taken up claims find it difficult to know whether they are on the territory of the United States or that of British Columbia. It is estimated by the government engineers at Ottowa that the cost of such a survey would be between four and five millions of dollars.—*Army and Navy Reporter.*

Deep Foundations.

Written for ENGINEERING NEWS,
BY COL. WM. M. PATTON, C. E.

Under this head the writer proposes to concisely discuss the merits and adaptability of the ordinary methods of securing a safe foundation in locations where the water and soft material are of great depth.

Timber Pile Foundations. The most expeditious, when the water is not too deep, and the most economical and common where a solid material underlies a softer stratum, is the ordinary pile foundation. It is quickly constructed and under favorable circumstances is strong and permanent. When the foot of the pile rests upon rock or other very hard matter, and where lateral stability is assured by the nature of the material or by artificial means, the support afforded is measured by the ability of the timber to resist a crushing strain, usually estimated by reliable authorities at 1000 pounds per square inch of the transverse section of the pile. The pile is supposed, in this case, to be constantly wet and not liable to the attack of sea worms.

In many localities an unknown depth of soft material exists, and the pile foundation can only afford support to an amount due to the friction between this material and the exposed surface of the pile. To extend the surface over which this resistance is to be exercised, the pile must be greatly increased in length. Experiment alone will in such cases determine the safe load per square inch of cross-section: other things being equal, this load will depend upon the nature of the material surrounding the pile. Mr. Rankine states that generally 200 pounds to the square inch would be a safe load; Maj. E. T. D. Myers, from actual trial upon piles driven in "an almost liquid mud," found that it required 13,000 pounds to start a pile driven 30 or 35 feet into this material 19 hours after driving. The structure upon which Maj. Myers made his experiments has been in use 14 years without further settlement.

The writer has had extended experience in pile-driving in the southern swamps where the material may be well described as "liquid mud," but though his work included pile-work for trestles, foundations for bridge abutments, etc,, no settlement has occurred in 14 years that he is aware of. But he has heard of cases where a gradual settlement year by year has occurred, but being uniform no damage was done to the superstructure. The test of a pile being driven sufficiently in such material is evidently independent of the penetration due the last blow. The writer has frequently found piles that sank from 1 to 2 feet at the last blow proof, after 12 hours undisturbed rest, against a number of heavy blows delivered in quick succession. Under these conditions such foundations can be considered safe and permanent.

But with pile foundations in a river with a rapid current, subject to scour from a too great contraction of water-way, or to undue pressure from ice-gorges acting against the masonry resting upon them, their safety or stability can not be assured. Their condition is always precarious, causing constant anxiety and requiring constant care. The use of a large quantity of rip-rap, with yearly soundings and examination by divers,and periodical additions of rip-rap, will generally defer the evil day. Such foundations under circumstances such as these are not to be commended.

To this class of pile foundations also belongs the open caisson, sunk by building the masonry inside and, by various methods, allowing it tofinally rest upon the heads of piles cut off at, or below the bed of the river. This method is used generally where the depth of water is considerable, and under proper conditions affords a reliable foundation, but the time and cost of construction is greatly increased thereby.

Open Caissons. Under this head is included all timber and iron caissons, of whatever design and general construction, and all iron cylinders, open at both ends.

These open caissons, sometimes called cribs, can be and have been resorted to in sinking through great depths of water and soft material, such as silt, sand or gravel. This is accomplished by removing the material from within the caisson by some form of dredging; or by cutting up the material by a water-jet and removing it mixed with water by a pump. In sinking the caisson as the work progresses, additional weight is applied as required to overcome the frictional resistance; this weight to be removed when the final depth is reached. The objection to this method is the possibility of meeting wrecks, logs or other obstructions in the underlying materials, which would either greatly increase the difficulty and cost, or perhaps render further sinking impossible. One of its advantages is that work is at all times carried on in the open air; but the cost of such foundations increases in a rapid ratio with the depth to be sunk, and the building of the pier or other construction is delayed until the final depth is reached. The building of masonry in such cribs is slow and costly; and, as the water can not always be entirely pumped out, the condition of the bottom must be ascertained by divers, if the depth is not too great, or soundings only must be relied upon; and furthermore under these conditions a portion of the work itself must be laid under water.

When the water can be pumped out and the bottom laid bare, this method can be considered safe and permanent if not economical. In certain cases when the limit of depth attainable by the pneumatic process is exceeded, the engineer may be compelled to resort to the dredging and open crib process; but there is always a doubt of the ultimate stability of the work unless the water is removed. Concrete deposited under water may be good, but who knows it?

The Pneumatic Process. Under this head are considered timber and iron caissons and iron cylinder sunk by the use of compressed air. Among the many advantages of the process are, its absolute certainty, as removing material from below and adding weight above leaves no doubt as to the practability of reaching great depths; it can be used regardless of the material overlying the rock or ultimate foundation, and all obstructions can be removed, and it is comparatively rapid in its progress, the sinking goes on as fast as in the open caisson and the building upwards is progressing at the same time and with corresponding speed, the weight added to aid in sinking is a part of the foundation and is consequently useful and permanent. In addition to these advantages the actual removal of the material either by blowing-out or pumping is as uniform and rapid at one depth as at another, the cost only being increased somewhat by the greater depth. The results attained are satisfactory as ample opportunity is afforded to thoroughly examine the bottom and, if necessary, to remove all disintegrated rock; the bottom can be levelled to any desired degree by blasting, and finally the bottom can be thoroughly washed and the concrete or masonry structure commenced upon a perfectly clean surface. A structure so founded can be classed as of undoubted stability.

The important question now is whether we have reached the limit of depth to which this method will apply. The writer believes we have not, after due consideration of the circumstances and conditions under which this work is usually carried on. In this connection it is useful to follow the average worker in compressed air from the time of entering the caisson until he comes out. This average man generally comes to his work comfortably, sometimes even fashionably dressed, he disrobes in an uncomfortable and exposed room or shed, and in many cases put on little else than a hat and a pair of rubber hip-boots in which to do his work. He then enters the air-lock and the upper door is closed, the supply cock is opened, the compressed air rushes in rapidly and the temperature rises considerably over 100° F.*

As a consequence of this treatment a full and rapid perspiration sets up in the man, attended by an equally rapid evaporation due to the high temperature of the air and its capacity for moisture; in this condition the laborer passes into the working chamber of the caisson where the temperature rarely exceeds 85° F. and commences his task; this work keeps up the perspiration and the man goes through a sweating process for 3 or 4 hours. When he comes out for his meals, the conditions are reversed; he enters the lock, the lower door is closed and the exit-valve is opened wide; the compressed air now escapes violently and a dense fog fills the lock and this perspiring, over-heated man, without a dry thread on him, at once finds himself in a cold and damp atmosphere, which chills him and suddenly checks the perspiration. When he passes outside, either in winter or in summer, he sits down for half-an-hour in an exposed shed by a stove, or in the open air, and then repeats the process. The same man frequently passes through the lock several times in a working day, each time subjected to this abnormal change. While in the working chamber he is breathing an atmosphere poisoned by the smoke from many candles and by the exhalations from the body and lungs of his fellow-laborers (from 10 to 25 men usually form a caisson shift), and this atmosphere is frequently further charged with foul emanations from decaying organic matter in the soil. With his lungs charged with these animal poisons and with soot from the candles, which he will expectorate for weeks and even months after stopping work, is it any wonder that the workmen will suffer from the "bends," or that some are paralyzed and others die?

Much of this evil conditions of affairs can be lessened if it cannot be entirely removed. Thorough ventilation is a first requisite, for while the air leakage under the cutting-edge is sometimes sufficient, it frequently happens that it is not so; especially after the concreting has commenced, when the heat increases, and the smell of the cement is added to the other elements of discomfort. In the second place, candles, lamps or anything that generates unconsumed carbon should be abolished and the electric light substituted. Then there should be one or more large air-locks connected with the main lock; the men should be forced to pass through these locks slowly, in a temperature regulated by means of cold water or steam pipes if necessary; the men should be required to wash, rub and dress themselves before being exposed to a sudden fall in temperature consequent upon a rapid reduction of temperature; and they should not be exposed to cold or wind until the system has practically regained its normal condition.

As far as could be observed at the work on the Havre de Grace Bridge foundations, the human system is not effected by an increase of pressure, the air seems to thoroughly permeate even the remotest vein and tissue; for were this not so pain would evidently follow any obstruction to its free passage, due to unbalanced pressure. A cold in the head, stopping up the nostrils, is production of acute pain; the same result following any obstruction in the Eustachian tubes leading to the ears. The simple

*106° F. was the highest recorded at the Havre de Grace Bridge, but the writer is convinced that the actual temperature exceeded this by several degrees as the hotest moment is just as the air is equalized and the lower door is being opened, but before the thermometer can register this highest temperature a change takes places from the mixture of air from below.

muscular action of swallowing will open these tubes and usually relieve the pain, though with some persons this remedy fails and the pain becomes intense and unbearable. Beyond these inconveniences a healthy person generally experiences little trouble while in the compressed air. In some cases the workmen is attacked upon leaving the lock, when one remedy is to return into the compressed air again. The pains in the limbs may continue for days and even weeks and they are at times very severe. While under pressure the men work with a zeal and earnestness rarely seen in the open air; many of them will labor from 12 to 16 hours in the compressed air, if permitted to do so, or necessity requires it. The regular working time for ordinary depths is from 6 to 8 hours with an inter-mission of half an hour for a meal

At the Havre de Grace Bridge the greatest depth reached was 90 feet below high tide; there were 3 or 4 deaths and about the same number of cases of permanent paralysis. The lighter and temporary troubles were frequent, chargeable in a great degree to excessive drinking, when they should have been resting or sleeping. Though this dissipation should undoubtedly render a person more liable to "caisson diseases," as it would to any other disease, there is no satisfactory evidence that the worst cases in this work could be traced to this cause.

Outside of the dangers directly resulting from the effect of compressed air, there are none to be apprehended when proper care and judgment are exercised; in any event, nothing more serious than usually attend all important and difficult structures while in progress.

The necessity for deep and difficult foundations may, in many cases, be done away with by using long spans of the suspension or cantilever type of bridges. The freezing process may be destined to overcome all difficulties in reaching a great depth, but its possibilities and capabilities are as yet undeveloped in this country, and it is premature to offer an opinion or prediction upon its success or failure. Its future application and development are in good hands and we can safely await the issue.

Suspension of caisson while sinking. Except under peculiar circumstances, expensive and strong supports and framed trusses are not required to hold a caisson in position while sinking. If the current is strong and variable and the depth of water great, the caisson must evidently be protected against the influence in its descent, and this may be done by a proper suspension system, or by breaking the current and producing dead water by well known methods in the space occupied by the caisson. But this suspension or protection need only be utilized until the caisson is well embedded in the soil, after that the caisson will generally take care of itself, as it is as difficult to move an enormous mass out of a direction once assured as it to restore it to its true line of descent should it from any cause go astray. The continual application of small unbalanced forces will accomplish a great deal, but the change of direction under their influence will in the short time and the depths usually sunk, be confined within narrow limits. A reasonable margin in the size of the caisson will generally provide for any light variation; or, better still when possible, to leave the length of span unfixed until the deviation in sinking is known. This need not interfere with progress on the superstructure as a limited change in span can be made in the end panels without materially disturbing any previously calculated strain-sheet.

In any method of lowering caissons by rods great care is required to lower all simultaneously and equally; otherwise the rods will bind, and delay and expense inevitably follow. At the Havre de Grace Bridge, suspension was not resorted to, and with a margin of about 3 feet outside of the masonry limits, there was always ample room. The greatest change of position there was not over 18 inches, and the only effect of this deviation was to throw the center of gravity of the superimposed weight a short distance out of the vertical, passing thrqugh the base-center. With a perfectly unyielding foundation this condition of affairs was of little moment.

An interesting question for the builder of a caisson is, what, in this case, constitutes substantial framing, where strength is requisite during the sinking, and uniformity of bearing and solidity only are finally required. Strength and solidity, combined with simplicity and a due regard for economy should control the design. The latter elements require that the dimensions and form of the several parts should vary as little as possible, and there should be as little elaborate framing as possible, for unusual dimensions in cross-section and intricate-joining occasion delay and expense. Planing abuting faces is entirely unnecessary, uniform bearings can be obtained with ordinary and reasonable care. On the Havre de Grace foundations each timber course was adzed down to a reasonably close level surface, and the succeeding course was thoroughly bedded in cement paste; this method prevents leakage and limits the damage by fire, both of which points should be carefully considered in pneumatic structures. All bracing in the crib, caisson and cofferdam should be designed to give ample support against the various strains and pressures involved and at the same time so placed as not to interfere, within reasonable limits, with other necessary and important work.

Concrete.—Concrete as a substitute for masonry below the water surface, claimed to be as durable and more economical and expeditious than masonry, has been used to such an extent and has been so highly recommended as a component, if not ruling part, of a foundation, that any discussion of this subject without a reference to concrete would be incomplete.

Concrete used in foundations should be compact and solid, a Coignet Beton in sand and cement without broken stone. Such a concrete has proven itself strong and durable. Broken stone is added to concrete mainly for economical reasons, though there are some engineers who believe that the concrete is increased in strength thereby and will better resist abrasion. The main idea should be to have a sufficiency of paste to insure the ultimate homogenity and solidity of the mass. An actual and determinate proportion of sand should be required, based upon the volume of the cement when loose, and upon the strength of the cement paste under varying proportions of sand as determined by experiments. But an exact proportion of broken stone, even granting that it can be obtained of uniform size, is evidently not necessary to the obtaining of a compact, solid mass. The proper quantity of water required has been already fully discussed in a previous paper by the writer, published in ENGINEERING NEWS.

Concrete when once placed should not be disturbed; it should be rammed as deposited and loose or rounded stones should be placed upon the mortar and rammed into it, rather than to put the mortar upon these stones. The practice of using large stones thrown upon fresh concrete, or bedded in mortar with concrete rammed around and over them, is beyond question economical, and the compound is likely to bear all the weight to be brought upon it, but whether the *best* results are thus obtained is open to question. The product is a non-homogeneous mass and to this extent prevents the formation of the monolithic structure supposed to be the characteristic of concrete masses. To push this method of construction to its final and logical conclusion would do away entirely with concrete and substitute rubble masonry.

Concrete as usually employed is expected to bear compression alone; few cases arise in foundation work where it acts as a beam and it should never be so used. This being the case why should a tensile test alone govern the quality of the cement used? Beton, concrete or mortar, after setting, is looked upon as a species of artificial sandstone; that is, it is a solid composed of broken stone and sand, or grains of sand only, cemented together by something, whether that cementing agent is carbonate of lime alone, or silica, alumina and lime combined. It is purely a granular, not a fibrous compound; and as far as we know the granular solids have a high compressive strength and the fibrous solids a comparatively high tensile strength. In the face of these facts it is natural to again ask why a test for tensile strength alone should determine the character of a substance which, under ordinary circumstances is to be used only in compression. The argument would probably be that a cement showing after setting a high tensile strength would prove equally good in other respects. But is this true of other granular substances? Are not granular substances as a rule, possessed of high powers of resistance to crushing and a comparatively low tensile strength? Cast-iron and a multitude of other substances may be mentioned as examples.

In answer to the question, "What tests should then be applied?" the writer would suggest. First, a sample test as to the hardening of the cement, when mixed with sand in various proportions and after a greater or less time of exposure in water and in the open air; this would determine the quality of the cement as far as setting is concerned. Second, practical tests as the work progresses, of the quality of the concrete. As some cements require time to harden fully, we would have to rely mainly upon the sample test, and knowledge of results obtained with the same cement in other works.

Where very large quantities of cement are being used, it is, however, idle to advocate certain theories and hobbies with the expectation of carrying them out in practice; the matter of proportions is practically regulated by the judgment and experience of the engineer and the cement or sand available, sand coarse or fine will require more or less cement and the size of the broken stone will regulate the quantity of cement paste in the concrete. It is the business of the engineer to do substantial, permanent work at the minimum expenditure of time and money.

Trying the Hodges Elevator.

The inventor of the safety appliance used by the Hodges Elevator Company may certainly claim pre-eminence in the way of testing cars, for it would be generally considered suicidal on the part of most inventors of so-called safety appliances to ride in their cars and disconnect the hoisting cable fifty consecutive times while the car was at full speed, and yet this is what Mr. Hodges did on Saturday last at the factory of the Van Derveer & Holmes Biscuit Company, the car in every case stopping with but a slight jar.

On a former occasion Mr. Hodges tested a car 101 *times*, and the last four trials have averaged 87 times testing for each car. The elevator that can be allowed to drop while in motion so many times must certainly be furnished with a safety appliance that is positive in its action and worthy the attention of the public.

This journal has previously explained the invention and shown that it is a decided departure from all other safety appliances.—ADV.

ENGINEERING NEWS Three months for One Dollar.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(Continued from page 28).

"Slow" and "Stop" signs are required on approaching a grade crossing on another line, a draw-bridge or any such place when extra caution is required. These signs can be made alike according to Fig. 102, which gives full dimensions. The sign board is let into the

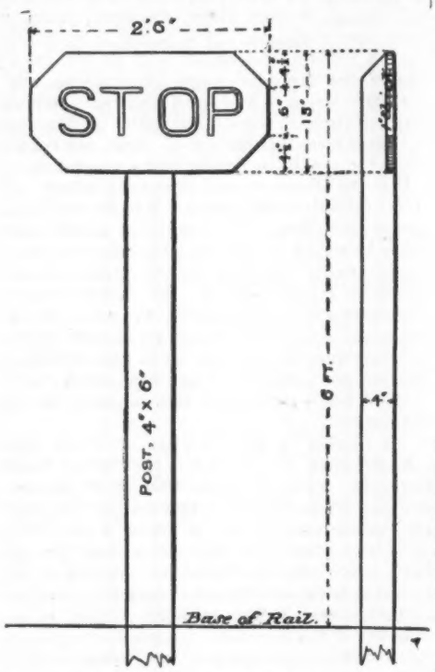

FIG. 102.—"STOP" SIGN.

post so as to be flush with its front and is fastened to it by 3-inch screws. For the slow signal the ground can appropriately be painted green, and for the stop painted red, those colors almost everywhere representing caution and danger. The letters *should be white, and also the post.*

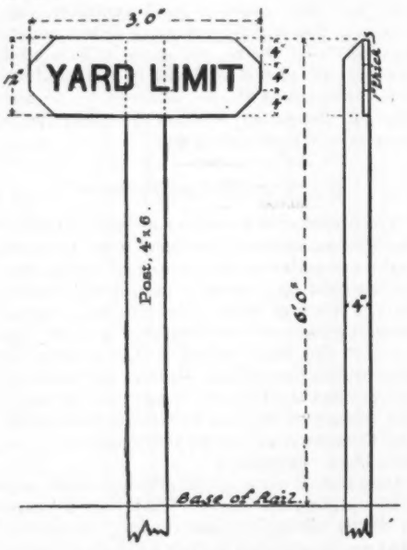

FIG. 103.—"YARD LIMIT" SIGN.

The limits of a yard or the boundaries up to which switch engines can work without special orders are usually marked by signs such as Fig. 103. The general construction is similar to the previously described stop sign, except that in this case the sign board and post are painted white with letters in black.

The dumping of cinders on the track should be carefully controlled, and if it is necessary

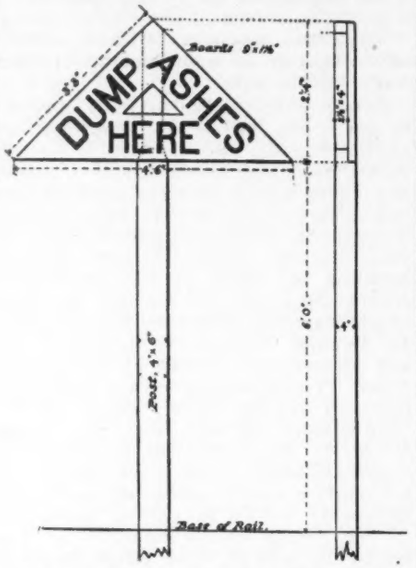

FIG. 104.—"DUMP" OR "CLEAN ASH HERE" SIGN.

to clean the engines' ash pans on the road, it should be done only at stated places, denoted by sign boards. Since the dumping grounds may be changed from time to time the sign should be of such form as to readily catch the eye. Fig. 104 shows suitable design. The board itself is composed of 3 boards 9" wide by 1½" thick, which are halved together at the corners and held together as well as to the

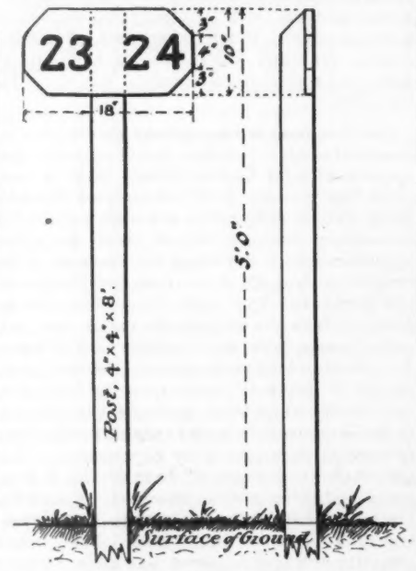

FIG. 105.—"SECTION" SIGN.

post by screws. The board and post are white with letters black and 6" high.

Such are the chief signs used to regulate transportation. For maintenance of way the principal one is that denoting section limits. This sign should be small, simply large enough to properly answer the purpose. Fig. 105 shows a design meeting the requirements, the construction of which is similar to the "stop" sign. The post and back of the board are painted white, the face of the board black with letters white. This sign should be placed parallel with the track and 10 feet from the rail as it is of less importance than those of the first class and should therefore be less prominent. The Pennsylvania R. R. makes small signs like these of cast-iron.

(TO BE CONTINUED.

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LITERATURE.

"The Elements of Railroading." A series of short essays reprinted from the Railroad Gazette. By CHARLES PAINE. Railroad Gazette, publisher, New York, 1885. Sm. 8vo. pp. 154. Price, $1.00.

The above series of articles is from the pen of a railway manager of long and varied experience, and his general remarks cover all that pertains to a railway from its survey and construction to its equipment and the movement of passengers and freight. His advice to engineers and the other employees, and to the promoters of railway projects as well, abounds in common sense and attention thereto would redound both to the credit and profit of all concerned. The only fault, if that can be called a fault, which would have extended the present volume vastly beyond intended limits, is that the various divisions of this important topic are treated of in a very general way; there are no illustrations and little detail of specific form or dimensions. But the book is valuable notwithstanding; valuable for practically covering the entire range of railway construction and practice in a concise and very readable form; the experience and expert knowledge of its well-known author asserting itself on every page.

The Windmill as a Prime Mover. By ALFRED R. WOLFF, M. E., Consulting Engineer, Associate Editor "American Engineer," M. Am. Mech. Engineers, etc., John Wiley & Sons, Publishers, New York. Price $3 00.

The author is entitled to credit for here first bringing into concise form in one volume, much matter on this important subject that has heretofore only been available in a scattered form, in periodicals, pamphlets, and chapters of text-books.

The scope of the work includes the use of the windmill for various purposes, the number used in America, its relation to the steam engine, etc. Chapter I is devoted to wind, its velocity and pressure; Chapter II, to the impulse of wind on windmill blades; Chapter III, to the early history of windmills; IV, to European windmills, and V, to those of America. Succeeding portions of the book treat of centrifugal governed and other types of mills, velocities, experiments and the capacity or economy of windmills.

The book is very well illustrated and the author concludes with a statement of useful data regarding windmill practice.

A Manuel of the Theory and Practice of Topographical Surveying by means of the Transit and Stadia; including Secondary Base-line and Triangulation Measurements, and the Projection of Maps; accompanied by Reduction Tables and Diagrams, Plates of Map-lettering and Topographical Signs. By J. B. JOHNSON, C. E., Professor of Civil Engineering, Washington University; formerly engineer on the U. S. Lake and Mississippi River Surveys. Designed for the use of Students and Engineers in the Class-room, Field, and Office. New York, John Wiley & Sons' Publishers, 1885, 8 vo., pp. 112. Price, $1.25.

In view of the adaptation of Stadia Surveying to many other purposes than the survey of government lands, the present work is a most useful addition to engineering literature. It is the most economical and the most expeditious method of obtaining correct contours, and the information thus obtained of the surface of the country being investigated, is of the utmost importance in intelligently locating railroads and canals, ditch and pipe-lines, or in examining drainage basins, reservoir, dam, or bridge sites.

The author enters carefully into the theory and practice of Stadia measurement, describes the instruments and their use, and give cost per square mile of certain work, together with useful practical advice upon base-line measurement, triangulations, projection of maps and the lettering and topographical symbols to be used. An engraved diagram is issued with the work (at an additional cost of 50 cents), which is intended to reduce the labor in correcting the elevation readings of the stadia rod; it gives distances to 500 yards, or metres and elevations to 50 feet.

A Review of the Situation.

The contrast between the present time and 1879-1880 serves to illustrate the extent to which business activities are devoted to the production of articles not necessary to the comfort of man and the enterprises in which there is no profit to their projectors. We are accustomed to say now that business is at a low ebb, and yet there is an excess of everything that the people need. A small percentage of the producing and distributing capacity suffices to meet the wants of the country, and the rest remains idle. In the active times succeeding resumption a much larger percentage was employed, and its product was used up in the form of luxuries, was laid by as accumulated wealth

or was wasted. It is appalling to think how much of the capital and labor of the years just after the resumption of specie payment was wasted. Vast sums of money were invested from which there has been no return. The one compensation for this waste is the fact that the people get the benefit of many conveniences, such as railroad lines in certain localities, and property in the vicinity is made more valuable by enterprises which in themselves are unprofitable. Everybody would like to see a revival of business but we do not want one of those booms in which a lot of empty schemes grow up to give a few people profits on paper and finally collapse. The margin between the present condition of affairs and a highly prosperous status of business is very narrow, The great mercantile houses are doing well; most of the railroads that can offer any apology for their existence are getting a reasonable income on a fair valuation of their property; and a little increase in the demand for capital would give lenders all the income on their funds that they could properly expect in a country where capital has grown so rapidly as it has in the United States. Business concerns of minor importance and prestige are not doing so well as could be desired, and all persons that are willing to work cannot get employment. If speculation can be kept down and a gradual increase in traffic secured that will take up the idle people of the country our affairs will be in excellent shape. The trouble will be that as soon as there is any new movement in trade, speculation will start up, and then the evil of an unequal distribution of profits and wealth will follow.—*Chicago Tribune.*

Business Honor.

The men who are trying to palm off inferior goods on the chance that the blemishes will be overlooked, and the men who endeavor to back out of their bargains on the false pretext that the goods are not up to standard, constitute a class by themselves; there are not many of them; their numbers are decreasing; the game they play is not a winning one; the odds are very much against them; they score a point once in a while, but they soon discover that the money acquired in such ways is bought a great deal too dearly; if they get the best of a man once, he will either shun them altogether thenceforth, or else he will watch for an opportunity to get square with them. The merchants of the trade, as a whole, comprehend the situation perfectly; they take particular pains to serve their customers so acceptably that they will never hear a murmur of disapprobation; their customers emulating their example of just dealing, pay their bills promptly and renew their orders periodically. Those on both sides, who are most punctilious in keeping their engagements enjoy, in the main, the largest measure of prosperity; their probity becomes a part of their capital. It enables them to make sales promptly, which saves interest and lessens their requirements of funds; it gives them opportunities to pick and choose for themselves to what buyers they will dispose of their goods, which essentially reduces the risk of losses by bad debts, and does away with the higgling and tossing to and fro of disagreeable imputations, which are the usual accompaniments of every controversy about mercantile contracts. All the houses that have grown strong and powerful have been noted for the promptitude and fidelity with which they have held to the bargains they have made, whether they were in their favor or against them. We cannot call to mind one exception, and if the experience of the proprietors of them could be cited, we have no doubt they would show that their success was largely attributed to the circumstance that they were popularly deemed to be entirely reliable. A good name is to a business man a possession of priceless worth, and sometimes it turns out to be in the nature of a productive investment. —Exchange.

New York's First Locomotive.

The driving wheels of the first locomotive engine built in the state, and the third one constructed in America, were seen yesterday in West Albany, prior to their being boxed up for shipment to New York. These wheels, in a new coat of green paint, rested against the frame of the foreman's office in the machine shop. On the hub of each in yellow letters was: "De Witt Clinton, first trip, August 9, 1831." Each weighed 350 pounds. In diameter they are about 5 feet. From a solid hub in the center, spokes less than an inch in diameter are set, similar to those in a wagon wheel, but further apart, and extend to a felloe half an inch thick and 3 inches wide. On the outer edge is a series of holes which originally held a steel flange in place. The workmanship is crude compared with that of to-day. The driving-wheels now turned out at West Albany weigh 1,900 pounds each without the tire, or more than five times as much as the wheels of the Clinton, which was the first engine that made a trip in this country, both of its predecessors breaking down. The engine was kept as a relic in the repair shops at West Albany until ten or twelve years since, when it was broken up, and the copper and brass sold to locomotive-works. The driving-wheels were tossed into a pile of old iron. Shortly after Master Mechanic John Orton assumed charge of the works, two years since he was having things cleaned up, when he run across these old wheels. He had them hung up, and they remained suspended until the visit of some of the Central Hudson River officials recently. It was thought these old drivers would be a curiosity to be suspended in the Grand Central Depot in New York, and so the order was given to paint them up and forward them. They were shipped last night. —*From the Utica Observer.*

Preserving Processes.

From a Washington Special.

The report of the Naval Board that the so-called wood preserving process which the Navy Department under Mr. Chandler was prevailed upon to buy and for which $156,168.62 was paid is entirely worthless makes rather interesting reading for the other board of naval officers who recommended its purchase. Besides the cost of the process several thousands of dollars were spent by this first naval board in so-called investigations of the value of the process, transportation to different parts of the country, hotel bills and other items of that character.

There was a moth-preventive, mildew repellant and waterproofing process used by the War Department some years ago. It was used in waterproofing soldiers' clothing and tents. Over $100,000 was gobbled up by the waterproofing ring. Congress investigated the matter, and it was found that the wonderful process consisted in simply dipping the clothing and tents in rain water. This waterproofing ring had an attorney here who received $10,000 per year for his services in lobbying to secure the purchase of the waterproofing compound and having the government continue its use.

A similar fraud was developed in the Bureau of Engraving and Printing of the Treasury Department soon afterward. A New York man who was influential with the powers that managed affairs at that time, secured the adoption of a waterproofing compound to be used in making greenbacks and fractional currency waterproof.

He claimed that the paper which was not treated with his process would carry disease from one person to another, and besides would wear sooner than if not treated. Nearly $200,000 had been expended in paying for the use of this process when a Congressional investigation was ordered into this matter also. The inventor of the wonderful compound for waterproofing paper at first refused to divulge the secret, but it was forced out of him. It consisted of simply soaking the paper in a barrel of water in which a bar of soap and a handful of alum had been dissolved. The men implicated in each case escaped prosecution, which will probably be the result in this wood-preserving process.—Savannah *Morning News.*

Instructive Figures.

In an address at Newton Upper Falls, Otis Pettee recently made the following valuable presentation of statistics touching the vast volume of money expended in this country in the purchase of the single item of liquor:

"In looking over the latest statistical returns of the United States, a few days since, I found the item of value of manufactured liquors, including the liquors imported from foreign lands, to amount in the aggregate to $944,629,580. My curiosity led me to reduce this amount to avoirdupois weight in silver currency. Upon inquiry at the sub-treasury, I learned that 1000 silver dollars weighed 58 lbs. and 12½ ozs. Using this weight as a basis it will require about 340,000 silver dollars to weigh 10 tons of 2000 pounds each, which is an ordinary freight-car load. To transport the 900 and odd millions of silver dollars would require 2775 cars with ten tons each, and allowing 30 cars for a train, will require 92 locomotive engines to draw them. The ordinary length of a car is 30 feet, and the entire trains with their engines will reach 16½ miles to transport the liquor money made for a single year in this country. If the same amount of money was expended for the necessities of life it wouldprovide a barrel of flour, a ton of coal, 30 pounds of beef, and 2 bushels of potatoes for each and every man, woman and child in the country, and if we add the tobacco bill, I rather think it would furnish clothing also. Take the subject home with you and think it over."

Steel Castings.

At the recent meeting of the American Institute of Mining Engineers, at Chattanooga, Mr. Pedro G. Salom, of Thurlow, Pa., read some notes on the Manufacture of Steel Castings, stating some of the difficulties encountered in the work. Although castings were made of steel ten years ago, there are only six establishments now in the United States engaged in their maunfacturé, and there are probably not 10,000 tons produced each year. Comparing the three processes, the crucible, the Bessemer and the open hearth, he declared the first could never be successful except for making hard and brittle castings, the result being full of blow-holes or the fluid metal being too pasty to run into the moulds. By increasing silicon to from ¼ to one per cent., a perfectly solid casting soft enough to machine well can be obtained; but it has lost all ductility, though with a tensile strength of 50,000 pounds; and not as brittle as pig metal.

Bessemer castings are less homogeneous and higher in carbon than those produced from open-hearth steel. Some very solid cranks of Bessemer steel, though perfect in appearance, all broke in half when an attempt was made to shrink them upon the shafts. But open-hearth cranks made at Chester were easily shrunk, and are now in excellent condition after four years' use. Mr. Salom predicts, however, that all castings required for this and similar purposes will eventually be made from Bessemer steel, with improvements in the present mode of manufacture. An exceedingly interesting discovery announced by Mr. Salom is that, other things equal, each 1-100 per cent. of carbon added to the steel increase the tensile strength of the castings by approximately, 1,000 pounds.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.: M. INST. C. E.

(CONTINUED FROM PAGE 30)

DCCLXIV. ROCKVILLE, CONN.

Rockville, Tolland Co., Connecticut, is in lat. 41° 50′ N., long. 72° 25′ W.

Water-works were built in 1847, by a private company, taking the supply from Snipsick Lake, which has an area of 524 acres. A dam 51 feet long, and 18 feet wide, impounds the water at 280 feet above the lowest part of the town.

Distribution is by 7 miles of cast-iron pipe of 15 to 2 inch diameter, with 50 fire hydrants and 500 taps. Cement lined wrought-iron pipes were first used, but proved so unsatisfactory that they have been entirely replaced by cast-iron. Service pipes are of lead and wrought-iron. The town does not pay for the use of fire hydrants. No meters are used.

The capital stock of the company is $22,050. The works to date have cost $60,000. The population in 1880 was 5,902.

Geo. Maxwell is President, and J. C. Hammond, Jr. Secretary.

DCCDXV, RUTLAND, VT.

Rutland, Vermont in lat. 43° 40′ N., long, 73° W, the county seat of Rutland Co., is on East Creek.

Water-works were built in 1856 by the village taking the supply from East Creek just below the confluence of Chittenden and Mendon branches. A gallery 150 feet long was dug near the creek to which the water was expected to filter through the porous bank of the creek. This proving unsuccessful a ditch was dug, filled with loose stones connecting the gallery and creek, and in 1880 a pipe was laid in the ditch passing through three brick walls provided with screens. All of these expedients proved very troublesome, owing to the large quantity of saw-dust coming from 8 mills further up the streams, requiring constant care and at times threatening to cut off the supply altogether. In 1881 these works were abandoned and the entire supply taken from Mendon river on which but two saw-mills are located. The water is conducted in an old water-course to a settling reservoir 150 feet long, 50 feet wide and 4 feet deep, over the dam of which it flows through a bed of gravel to another reservoir 200 feet long, 80 feet wide and 9 feet deep. From a point 4 feet below the surface in this reservoir the water passes in a 12-inch cast-iron pipe to the gallery before mentioned, and is thence conducted to the distributing reservoir in the village, 3½ miles distant in cast-iron pipes of 12 and 6-inch diameter.

Distribution is by 15 miles of cast-iron pipe of 12 to 6-inch diameter with 53 fire hydrants and 1,500 taps. Service pipes are of wrought iron. No meters are used. The daily consumption is 1,000,000 gallons.

The works have cost $100,000. The bonded debt is $82,500 at 6, 5 and 4 per cent. The expenses of maintenance for the year ending April 31st, 1884, were $5,563, and the receipts $12,926.

The population in 1880 was 7,592. J. M. Davis, is Superintendent.

WATER.

THE Red Wing, Minn., city council at its recent meeting set apart $5,000 for a permanent water-works fund, by buying up with city funds the $5,000 unsold authorized water-works bonds, and canceling the same.

THE people of Birmingham, Ala., appointed a commission to examine the sources of its water supply and its possible pollution, and it has unanimously condemned the water and suggested the necessity for an immediate movement in some other direction.

THE efficiency and capacity of the reservoirs upon the upper Mississippi and its tributaries are to be tested this year. Three of the dams are finished, and enough water is held back in them to effectively increase the stage of river when the reservoirs are opened.

ORWIGSBURG, Pa., is advertising for bids for digging, laying and covering water-pipe in that place. Work is to commenced on Aug. 1st, and be completed on or before Oct. 15th, next.

ARTICLES of association have been filed with the secretary of state of Wisconsin, incorporating the Milwaukee Hydraulic Air Compressor company of Milwaukee. The capital stock is $25,000, and the incorporators are James B. Erwin, C. T. Benedict and G. D. Basse.

THE rainfall in the Croton watershed, April 1 to June 30, was 5$\frac{77}{100}$ inches; less than in the same period for 18 years. On June 12, the natural flow of the Croton did not meet the demands and by June 30, 1,320,000,000 gallons had been drawn from the reservoir.

LANCASTER, PA., has lately discovered that its sparkling well water is unfit for human consumption. A late analysis of a well, at one time regarded as one of the purest in the city, shows chlorine, albuminoid ammonia and nitrates in considerable excess of the requirements of good water.

THE purchase of the water power of Piper & Gibbs, at Piperville, Wis., on the Rock River, is being considered by the Ixonia water club of Watertown. The purchase if made will be with a view of reclaiming lands injured by the overflow of the Rock River recently. The sum of $4,000 has been offered, but the owners want $8,000.

THE largest ditch improvement yet contemplated in Auglaize County, O., is Pusheta ditch in Clay township, just surveyed by Engineer Samuel Craig. The aggregate length of the main ditch with its six branches is eleven and twenty-two one hundredth's miles. Seventy-six farms are taxed for the construction, and seventy-thousand cubic yards of earth are to be removed, the estimated cost of which is eleven thousand five hundred and fourteen dollars.

ASPEN, COLORADO, July 2nd.—Simmons & Abendroth, who had fifteen days in which to accept the franchise for a water-works system, which was given by the trustees after it had been ratified by a unanimous vote of the people, now say that they cannot build while such outside demands are made upon them. It is understood that D. R. C. Brown asks $12,000 for the right of way from Hunter's Creek. In the meantime the insurance companies are canceling their policies as rapidly as possible.

UNDER a recent reorganization of the Board of Health, of Newark, N. J., Messrs. Bassett & Nute, a very enterprising Civil Engineering firm of that city, have been appointed Consulting Engineers to the Board, and Mr. Bassett is at present giving two lectures per week before the Board's Inspectors, on sanitary subjects, principally house sanitation. A house to house inspection is well under way, and the Board enforces proper improvements. Plumbing regulations will soon be passed and the plans will come before the Engineers for inspection and approval. The sanitary condition of the city is rapidly improving.

NASHVILLE, July 11.—The Board of Public Works today awarded three of the most important contracts for years. They were for the construction of a filtering gallery of the new water-works system, Hicks, Holmes & Co., Indianapolis, $22,190; new pumping house, same firm, $67,280, and laying a new main from the present system to the new station up the river, Fred Spaulding of Memphis, $17,480. There were over twenty bidders for each contract. These are the last contracts of the new water-works system, which will be completed at a cost of over half a million.

THE Board of Water-works Trustees and Superintendent Whitelaw, of the Water-works Department, Cleveland, O., in their inspection of the high service storage reservoir on Kinsman street, found the work done according to contract. At the next meeting of the board it will probably be accepted from the contractors. The reservoir covers ten acres of ground near Kinsman street, one mile east of Woodland Hills avenue. It is 320 feet above the lake and has a capacity of about 18,000,000 gallons. The reservoir is for the storage of any surplus of water in the mains with which it is connected, and is for the high-service district in the eastern and southeastern parts of the city only.

THE SEWAGE OF PARIS in quantity amounts to about 96,000,000 gallons per day. Two great intercepting sewers join into one at Clichy where engines of 1,100 horse power pump a portion of the liquid to Gennevilliers and the surplus flows into the Seine; another intercepting sewer carries 44,000 cubic meters per day to the Seine at St. Dennis. The irrigated land at Gennevilliers is 1430 acres and the sewage annually poured out upon it is almost 3,000,000 gallons per acre. Experiments show that for growing beets even a larger quantity could be used, but for general purposes the present flow is well proportioned to the needs of the ground. The annual return from the crops is $250 to $300 per acre; and the rental paid has tripled within a few years and is now $38 per acre. Judging from present results French engineers believe that 10,000 acres would satisfactorily and profitably purify all the sewage of Paris.

AN analysis of the water supplied to Philadelphia, made for the City Councils by Prof. G. M. Malet, of the University of Virginia, Prof. T. G. Wormley of the University of Penna., and Dr. W. H. Greene, shows that the water in the Wentz Farm Reservoir, taken from the Delaware, excels the Croton water of New York in purity. The water from Flat Rock Dam on the Schuylkill is about as good as Croton; that from the Fairmount Dam is inferior to Croton, and the water taken from the Delaware at Kensington is very bad.

NEWS OF THE WEEK.

Contracting.

New Corporations.—ALBANY, July 13. The Consumers' Gas Company, of Buffalo, with a capital of $500,000; the Rochester Sewer Pipe Company, with a capital of $100,000, and the Rappaport Association, of New York, were incorporated to-day.

Bridging the Cuivre River.—TROY, MO., June 1.—The Lincoln County Court in session to-day, accepted the bid of Raymond & Campbell, of Council Bluffs, Ia., to bridge Cuivre River at Moscow. The bridge is to be of iron, and finished in sixty days. The accepted bid was $4,800.

Nebraska Gas Works.—The city council of Hastings, Neb., has granted a franchise for gas works, to be completed February 1, 1886. The city agrees to use fifteen lamps, to be located outside the electric light belt. There will be three miles of mains. Water-works are next in order.

W. Va. Pipe Line.—A force of workmen are now busy constructing a pipe line into Packersburg, W. Va., which is to connect the Camden refinery with the Marksburg oil region, the daily product of which is twenty-two hundred dollars.

Cleveland, O., Bridges to be Built.—On July 6th, the Cleveland, O. Board of Improvements approved a resolution of Councils providing for the erection of the belt line of high level bridges between the center of the city and the west and south sides. The first bridge is to be at Hill and Ohio Streets, estimated cost $557,235; another at Eastern terminus of Abbey Street is to cost $181,478 These bridges are to be of iron with stone piers.

Bridge Contract.—The Cleveland, O., Board of Improvements has accepted the bid of A. H. Delamater, amounting to $7,126.20, for the construction of the center pier and foundations of Main street bridge. The bid of the King Iron Bridge and Manufacturing Company for making the bridge draw, amounting to $15,816.88, with $1,800 allowed for the old draw, was accepted.

The Army Medical Museum.—WASHINGTON, July 8.—Proposals will be opened on August 7th, for the erection of an army medical museum and library. The building is to be three stories in height, with basement and attic, and will cover about 23,000 square feet of surface. The site selected is the southeast corner of the Smithsonian grounds. The work will be under the supervision of Colonel Casey, of the corps of engineers, who had charge of the completion of the Washington Monument.

Contract Case Decided.—The Secretary of the Treasury on July 7, decided a contract case, involving an important labor question. Bids were recently opened for stone work on the post office at Peoria, Ill., Messrs. Brainerd & Co., of Joliet, Ill., were the lowest bidders. A protest against their being awarded the contract was, however, filed by Messrs. Straub & Co., of Buffalo, the next lowest bidders, on the ground that Brainerd & Co., are contractors of the labor for the Illinois State prison, and would employ convict labor on the post-office. The matter was referred to Solicitor McCue, who gave an opinion that the department should not be expected to dictate the means by which contractors perform their work and that he did not believe the protest a valid one. Secretary Manning has sustained the Solicitor and the contract will be awarded to Brainerd & Company.

The Scotch Dredge a Failure.—The new dredge which was built some time ago in Scotland for Messrs. Hume Bros.' of the phosphate company at Coosaw, S. C., is lying at the opposite side of the river preparatory to going on the marine railway to be improved and put in condition for the return voyage across the Atlantic, to be returned to her builders. She has proved a failure, so far as digging phosphate rock is concerned. She was built for Messrs. Hume Bros., and they entered into an agreement with the Secretary of Treasury to allow them 90 days in which to test the machinery before paying the duty, which is said was $25,000. If she did not suit their purpose they were to be allowed to return her to the builders, in which case no duty would have to be paid. The cost of the machine, duty included, was between $90,000 and $100,000. It is a large and powerful dredge, with patent compound surface condensing engine, and has an immense well in which the endless chain works. This will be covered with iron riveted to the sides for the voyage.

Railroads, Bridges and Canals.

Oregon R. R. Mileage.—During the last six years the railroad mileage of Oregon has increased from 295 to 1,165.

The Oregon Improvement Company has completed the Cedar River Narrow Gauge road, 24 miles in length, and is now hauling 1,500 tons of coal per day over it.

Stony Creek Bridge, on the Canadian Pacific, in the Rocky Mountains, now being built, will be one of the highest viaducts in the world. It will be 290 feet high and 450 feet long.

The Rock Island will at once commence the construction of a new extension from Trenton, Ia., on its main line, to St. Joe, Mo. It is the intention to finish the road before cold weather sets in.

Western African Railway.—A railway has been opened from St. Louis, the chief town of Senegal, situated on the river Senegal, to Dakar, on the extreme point of Cape Verd, a mile and a half north of Gorée.

Baltic Ship Canal.—The long contemplated ship canal from the Baltic through Holstein to the North Sea is at last likely to be made. The cost of the undertaking is estimated at $40,000,000, of which one-third is to be borne by Prussia, the remainder being distributed over the other parts of the German empire.

St. John's Cantilever.—A St. John (N. B.) dispatch says: The gap in the railway system between the eastern provinces and the West was closed this morning when the last panel of the railway cantilever bridge over the Falls was completed. The bridge, which is a triumph of engineering science, will be formally opened in a few days.

Chesapeake & Nashville R. R.—The bids for the 34 miles of partially completed work of the Chesapeake & Nashville Ry., will be received July 11th. About fifty contractors have examined the work. W. H. Spradlin is Chief Engineer. On the completion of the road between Gallatin & Scottsville reaching the timber district, the balance of the work to Nashville will be let.

A New Line in Arkansas.—LITTLE ROCK, ARK., July 9.—The survey of a railroad from Coal Hill, in Johnson County, to cross Arkansas River at Roseville, and run into the coal country of Logan and Sebastian Counties, was commenced at Coal Hill yesterday morning by the Little Rock and Fort Smith Railway Company. These coal fields are supposed to be the richest in the State.

Change of Gauge.—July 8, at 4 p. m., the work of changing the gauge of the Nashville, Chattanooga & St. Louis railway was begun and the line was changed from five feet to four feet, eight and a half inches from Hickman, Kentucky, to Martin, where the road crosses the Illinois Central. The remainder of the line to Nashville, a distance of 141 miles, will be changed in a like manner in the near future.

The Pennsylvania Railroad Company, has obtained possession of the Waynesburg and Washington Railroad. This road is a narrow-gauge concern, twenty-eight miles long, running from Washington, Washington county, to Waynesburg, Greene County. It will be changed to the standard gauge, when it will be an extension of the Chastiere Road and ultimately part of the West Virginia, Kentucky and Tennessee Road.

The Penna's New Purchase.—WILMINGTON, DEL., July 11.—The Sussex *Journal* says that the purchase by the Pennsylvania Railroad of the Delaware, Maryland and Virginia Railroad has been pretty generally confirmed, and that it is thought that the Pennsylvania Road will assume control about August 1. The acquisition of this road gives the Pennsylvania the control of the whole railroad system of this Peninsula. The Delaware, Maryland and Virginia Railroad extends from Harrington, Del., to Franklin City, Va., with a branch from Georgetown to Lewes and Rehoboth.

A New Narrow-Gauge System.—Jonathan Barrett and F. McKeever, of Pittsburg, Pa., have been awarded the contract for building and equipping the Kingwood and Tunnelton Narrow-gauge Railroad. The road is only eleven miles in length, but it is the beginning of a most important system of narrow-gauge roads through the northern and western portions of West Virginia with reference to the ultimate construction of a long line of narrow-gauges through the interior and southern sections of West Virginia, Virginia and Kentucky.

The Northern Pacific Company have decided to extend the Fargo & Southwestern Line from La Moure to Ellendale, and thence on toward the Black Hills. The Chicago, Milwaukee & St. Paul people no longer try to conceal their intention of invading the Northern Pacific territory and working it for all it is worth, as illustrated in the case of Fargo Southern, and, naturally, the Northern Pacific will not be slow in retaliating. Ellendale is the northern terminus of the Hastings & Dakota Division of the St. Paul line. There is to be a sharp struggle for right of way and business in the James River country, and between this point and the Missouri.

Mobile and Ohio's New Gauge.—MOBILE, July 8.—The Mobile and Ohio Railroad Company changed the gauge of its road to-day from 5 feet to the standard, or 4 feet 8½ inches. The work of moving the rails was successfully accomplished in about 12 hours.

A Big Rail Shipment.—The commencement of one of the largest shipments of steel rails ever sent west from this part of the country passed throug Pittsburgh recently. It was consigned to the St. Paul, Minneapolis and Manitoba Railroad Company, and the advance train consisted of sixteen cars, each carrying twenty tons or 40,000 pounds of rails—in all 320 tons or 640,000 pounds. They were billed from the Cambria Steel-works, at Johnstown, and went northwestward by way of the Pittsburgh, Fort Wayne and Chicago Road and other Pennsylvania Company leased lines. The contract calls for 50,000,000 pounds, or 25,000 gross tons of steel rails. A great portion of the order has been worked up, and for some weeks these shipments will pass through this city en route westward. It will take 1,250 cars and over fifty engines and trains to haul these rails to their destination.—*Pittsburg Dispatch.*

Reaching Southward.—SPRINGFIELD, ILL., July 7.—The Wisconsin Central Railroad filed articles of incorporation in the Secretary of State's office here to-day for the construction of a line of road from Chicago, through Cook and Lake Counties, to the Wisconsin State line; also in a westerly direction, by way of Elgin, through McHenry County to the State line, and from Huntley, Ill., through McHenry, Boone, Winnebago, Stephenson and Jo Daviess Counties to Dunlieth; and from Belvidere and Rockford each to Beloit, Wis. It is understood that the primary object is the construction of a line from Milwaukee to Chicago to furnish an independent outlet for their Wisconsin road. The incorporators are Henry Allison, Edward Oleson, Henry Oleson, Edward Allison and Halver Oleson, all of Chicago.

Miscellaneous.

586 Trains per Day.—Out of one of the Paris railway stations, the St. Lazare, the other day there were dispatched 586 trains, carrying 206,144 passengers.

A Cable Road for Brooklyn.—At a meeting on July 8th, between the representatives of the Long Island Railroad Company and the Atlantic Avenue (Brooklyn) Railroad Company final articles of agreement were entered into by the two companies for the construction of the Brooklyn and Long Island Cable Railway, which will be laid from South Ferry via Atlantic avenue to Brooklyn avenue. It is probable that the work of construction will be begun at once.

Flood Rock in New York Harbor is about ready to be demolished. Eleven years and over three millions of dollars have been already expended on this Hell Gate improvement, and it is said that the work of loading the mines in Flood Rock will commence about the end of this month. The explosives to be used are 225,000 lbs. of "rackarock" and 75,000 lbs. of No. 1 dynamite; this is about six times the quantity of explosive used in blowing up Hallets Point, a few years ago. The great blast is expected to be ready in about two months.

An Elevator that is Safe.—A test of a remarkable nature was made at the factory of the Van Derveer & Holmes Biscuit Co., No. 58 Vesey street, this city, July 11th, where a safety appliance has been attached to one of the elevators by the Hodges Elevator Company. The inventor, Mr. Hodges, rode in the car throughout the trial, and, by means of a simple contrivance, detached the car from the hoisting cable, while it was in motion, fifty times. Mr. Hodges asserts that no safety appliance was worthy of its name whose inventor was afraid to personally test it at least a dozen times while the car was in motion.—*N. Y. Commercial Advertiser.*

Mosquitoes Eclipse a Locomotive.—We learn from a gentlemen just from up the country that June 24th the mosquitoes were so thick at Waldo that they completely enveloped a locomotive on the Florida Railway & Navigation Company's road. The engineer could not see ten steps before him, and in consequence the train was delayed several hours. Clouds of them were floating around in the air, thicker than the locusts in 1877, and completely obscured the rays of the sun. It was so dark that lamps had to be lit, and it was some three hours before mosquitoes cleared away sufficiently for the train to move on.—*Tampa (Fla.) Tribune.*

A New Explosive.—A Swedish Engineer, Herr Sjoborg, has produced a new explosive which he calls romite, and with which experiments have just been made at the fortress of Waxholm. The manufacturer claims that the explosive may be manufactured without any elaborate machinery, that it cannot explode even when closely confined, except when ignited, and that it cannot freeze, while its strength is very great, and its cost small. The experiments carried out with a breech-loader discharging shells to a distance of 1,090 yards, all the shells exploding with great effect, while the blasting operations were most successful. A number of engineers and military officials witnessed the experiments, which were declared highly satisfactory.

Effect of Asphalte on Workmen.—French laborers who work barefooted on asphalte pavements are subject to swelling of the legs, which has been attributed, says *Iron*, to the vaporization by the heat of the feet of a small quantity of the petroleum or mineral oil which is contained in the asphalte. "The nerves of the feet, which govern muscular action and the contraction of the blood vessels, form an extensive and very sensitive nervous network under the arch of the foot, where the skin is always thin, and the nerves are consequently easily affected." In England workmen on asphalte wear list slippers, and the swelling of the feet has not been noticed.

Great Britain's Indebtedness has increased during the past twenty-five years from $131,500,000 to $147,500,000 at the present time. Since 1861 there have been five administrations, under none of which the debt has shown a decrease. The greatest increase as well as the highest average cost of collecting the revenues and the amount of tax levied per each inhabitant have been under the premiership of Mr. Gladstone, who somehow bears the reputation of being the best financier in England. The average annual expenditure during the five administrations since 1861 have been $339,500,000, $365,000,000, $352,500,000, $396,000,000 and $443,300,000 respectively. In twenty-five years the annual cost of collecting the revenues has increased from $27,500,000 to $46,500,000, or nearly double, and the per capital tax in the kingdom from $11.50 to $12.43.

The Largest Galvanometer in the World.—There has just been completed at Cornell University the largest galvanometer in the world. It was built under the direction of Professor William A. Anthony, of the department of physics, and over a year was spent in the construction. The instrument contains all the accessories that are necessary for making the most complete and accurate measurements of any kind of electrical apparatus, and is valued at several thousand dollars. There are four circles, each two meters in diameter. Dr. Guyer, of the Stevens Institute of Technology, and several electrical engineers from a distance, with Profs. Anthony and Moter, of Cornell, are at present engaged in making tests by the aid of the galvanometer of the strength of the currents of a powerful dynamo sent to Ithica for that purpose, which is run at 1,200 revolutions a minute. The instrument has been mounted and placed in the physical and chemical-laboratory building, and will prove a valuable addition to the electrical engineering department of the university.

Underground Wires in Brooklyn.—The three Commissioners who have charge of getting the telegraph wires and similar electrical conductors in Brooklyn underground within the time specified by law—George W. Plympton, Prof. Rossiter W. Raymond, and John Reynolds—met and organized July 9th, in Mayor Low's office. Mr. Plympton was elected President and Mr. Reynolds Secretary. A resolution was passed that each company should furnish to the Commissioners before August 12, a description of the plan (if any) by which it proposed to place its electrical conductors underground and a full statement of the nature, location, and the extent of its conductors. If any company fails to furnish the desired information by that time it must file a written statement of its reasons for so doing with the board. The same resolution provided that no new wires or poles can hereafter be erected in Brooklyn without the permission of the board, acting jointly with the Department of City Works.

Mr. Reynolds suggested that the board should make as fall an inquiry as the limited time would permit into the subject before it, and he secured the adoption of a resolution inviting all persons or corporations interested in the adoption of a general underground electrical system to present their views in writing, or otherwise, as speedily as possible.

Monkeys Wrecking Railroad Trains.—Between a place called Niddivunda and Herebully there is a large tope, which is well-known to be infested with a host of monkeys. Having no other mode of occupying their dull hours, they are bent upon trying to destroy the Yumkur line. It would appear that these animals, about fifty or sixty, form themselves into two batches; they range themselves systematically, one half on one rail and the other half on the other. They begin by first removing the earth from the sides of the rails. Then they arrive at the difficulty of nuts and bolts, which, though they examine them very minutely, they cannot get over.

On the approach of the up and down train they wait till the engine is within a few yards then, with the utmost coolness, they simply jump on one side till the train has passed, and then resume their work. A remarkable instance occurred on one of these occasions. As the engine was approaching, the monkeys made their usual jumps, with the exception of one, who persisted in remaining on the line, the engine by this time being very near. Five or six monkeys, seeing the danger one of their number was in, made a sudden rush and dragged him off, some laying hold of him by the tail, others by the legs; anyhow, they saved him. They are now styled the Niddivunda gangmen by the guards and drivers.—*Madras Mail.*

Index to Periodical Literature.

Chaining.—*On the Precision of Chaining.*—By Prof. Mansfield Merriman. An account of the errors in chaining, together with a discussion of experiments made to determine the probable error of measurements by a Gunter's chain the probable error being deduced by the method of least squares. The value of the probable error is found to be about 0.4 links for a line one chain in length, 1.3 links for a line ten chains in length, and 4.0 links for a line one hundred chains in length. *Land Office Report of Secretary of Internal Affairs of Pennsylvania* for 1884, pp. 77-83.

Electric R. R.—*The Daft Electric Railway at Baltimore.*—The line is the Hampden branch of the Union Passenger Ry. Co., on which the grades and curves are steep and sharp. A 25 lb. T rail is laid on the Daft insulators in the middle of the track. The motor is a small car 12 ft. 6 ins. by 6 ft. 6 ins., or four 30 inch wheels, set 5 feet apart, c to c. Limit of speed 8 miles per hour. Track and plant are described, and details given of the motor machinery. Illustrated. *The Electrical World*, July 11, 1885, p. 13.

Gauge 3 feet 1¾ inch. Cylinders 14 inch by 22 inch. Four coupled wheels 36 inch diameter, leading pony truck. Steel boiler 14 feet 1 inch long, 44 inch diameter. Side tanks. Working presure 130 pounds. English build. Illustrated. *Engineering*, June 26, 1885, p. 697.

Hydraulics.—*Hydraulic Tables Based on the Formulæ of D'Arcy and Kutter.*—Shows how the work of solving problems in hydraulic engineering is diminished by the use of these tables. Several formulæ are given and described, with notes on data obtained by other engineers. The tables are for various conditions of pipes and velocities. P. J. Flynn. *Trans. Tech. Soc. Pac. Coast*, February, 1885, pp. 37 to 61.

Locomotives.—*Narrow Gauge Locomotives.*—English construction. Gauge 2 feet 6 inches. Cylinders 7 inch by 12 inch. Four coupled wheels 27 inch diam. leading Bissel truck, wheels 16 inch diam. mild steel boiler 10 feet 3 inches long, 27 inch diam. Side tanks. Weight 14,238 pounds. Morton valve gear. Drawing of engine, and valve motion details. *Engineering*, June 19, 1885, pp. 667 and 672.

Mexico.—*Population Chart of Mexico.*—An interesting article on the population and its distribution over the country; several tables are given of the population and area of the different States, and the number of inhabitants along the railroad routes. A chart has the completed and projected railroads marked on it, and shows the population of the States and cities by open and shaded circles drawn to scale. *Railroad Gazette*, July 10, 1885, pp. 434, 435.

Mining.—*Masonry Supports for Hanging Walls at the Tilly Foster Iron Mines.* An Exhaustive paper by Mr. L. G. Engel, describing the methods adopted for supporting the work and enabling almost all the ore to be removed. Brick arches of about 92 feet span are turned across the rooms and backed with concrete; the pillars being then cut away. The former mode of working is described, and the new plan given in detail the centering, concrete, plant, handling and supply of material, timbering, and construction being dealt with minutely. The paper is fully illustrated with, sketches, plans and detail drawings and has an estimate of the ore yet in the mine. *School of Mines Quarterly*, May, 1885, pp. 289 to 319.

Narrow-Gauge Locomotives.—*See* Locomotives.

Planimeter.—A brief description of this instrument for measuring areas on plans; and formulæ for ascertaining the area from the readings on the wheel. *School of Mines Quarterly*, May, 1885, pp 347 to 351.

Population.—*See* Mexico.

Rails.—*Rails and Track Labor.* Points out that money is better expended on heavier rails than in track labor, such rails being more economical and efficient; the durability of a 60 pound rail being increased 167 per cent. by the addition of 20 pounds more per yard. The subject is carefully considered in its engineering and financial aspects, with remarks on the traffic. Tables are given of comparative cost and efficiency. *Railroad Gazette*, July 10, 1885, p. 438.

Rainfall.—*Chlorides in Rainfall in* 1884. A paper on the amount of chlorides found in rainwater, from observations made at Staten Island. The results were unexpectedly large. A table of monthly averages is given, and notes on other observations. *School of Mines Quarterly*, May, 1885, pp. 335 to 338.

Rolling-Stock.—*Saloon Carriage of the London & North Western Railway (England).* Body 42 feet long; 8 feet 6 inches wide; length over all 46 feet. Carried on four axles, the inner ones fitted on the usual English plan, the outer ones having Webb's radical arrangement? Rigid wheel-base, 16 feet; total 32 feet. Steel underframe. Illustrated with detail drawings. *Engineering*, June 19, 1885, pp. 670 671.

Submarine Blasting.—*Removing Rock under Water.* Describes in detail the methods adopted in improving the harbor and Welland Canal at Port Colborne. Ineffectual attempts made with giant powder. Pure nitro-glycerine successfully employed. Holes bored by Ingersoll rock-drills, each hole being charged and exploded as soon as drilled. Debris removed by dredging. Tenders ranged from $6.50 to $40 per cubic yard; depth from 10 to 15 feet. *Min. Soc. Inst. Civ. Engs.* vol. lxxx, Session 1884-5, part 2.

Surveying.—*See* (Trigonometrical Surveying.)

Tay Bridge.—(*See* Bridge.)

Tower.—A paper on the iron tower 300 metres (984 feet) high, proposed to be built for the great French exhibition in 1889. The framework is composed of 4 uprights forming a curved pyramid; each upright has a section 15 metres (49 ft. 3 in.) square at base, and 5 metres (16 ft. 6 in.) square at summit, and is built of lattice work; these are 100 metres (328 ft.) c. to c., and are anchored to masonry foundations. The paper enters into the strains upon the structure and the details of construction, as well as its history and uses. Illustrated. *Memoires de la Societè des Ingénieurs Civils*, March, 1885, pp 345 to 370.

Trigonometrical Surveying.—A paper description of the methods employed by the English Ordnance Survey. Three systems of triangulation are used. methods of obtaining accurate readings, the plotting and solution of the triangles are described in detail. Tables and diagrams are given, with an outline map of the district mentioned. *Min. Proc. Inst. Civ. Engs.*, vol. lxxx session 1884—85, part 2.

Underground-Wires.—A paper by W. W. Jacques pointing out the technical difficulties in laying electric wires underground, and the way in which they are overcome. They require more care to be of equal efficiency with those overhead. The comparative values of different wires are given, and a table showing the cost of underground laying to be about 75 per cent. more than for overhead. *Science* July 3, 1885, pp. 6, 7.

Water.—*Discharge from Catchment Areas.*—A paper by J. Craig, M. I. C. E., on the determination of maximum flood-discharge and mean coefficient of discharge from catchment areas. the figures being obtained from observations in India. Several formulæ and tables are given, with sketches of the catchment basins of rivers. *Min, Proc. Inst. Civ. Engs.*, vol. lxxx, session 1884—85, part 2.

The Future Water Supply of Philadelphia.—Gives a brief history of the present water system, and a description of the proposed scheme by which water will be supplied by gravity from several streams north of the city, through conduits 12 feet diameter, on a grade of 1 in 6000, capable of delivering 210,000,000 gallons per diem to an elevation of 166 feet above city datum. Other schemes are also described and a discussion appended. Col. W. Ludlow. *Journal of the Franklin Institute*, July, 1885, pp. 17 to 33.

Market Report of Engineering Materials.

New York, July 16, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill. distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	1.9c. @	2.2c.
Tee	2.2 @	2.25c.
Beams and channels	3.0c. @	
Tank	1.9c. @	2. 0c
Shell	3c. @	3¼c
Steel plates, Tank	2¾c. @	3c.
WROUGHT-IRON PIPE.. PITTSBURGH.		
Butt welded, black.....Discount	45 @	47½
" galvanized..... "	35 @	37½
Lap welded black..... "	65c. @	
" Galvanized..... "	45 @	47½
Boiler tubes..... "	57½ @	60
RAILS.		
Steel (large lots at mill).....	$27.00 @	27.50
Old rails.....	16.50 @	17.00
Old rail steel.....	16.50 @	17.00
R. R. spikes.....	1.8 @	1.9c
R. R. splice-plates.....	1.65c. @	1.75c.
R. R. Track Bolts.....	2.6c. @	3c.
Barb-wire fencing, galvanized.....	4¾c. @	5¾c.
" " painted.....	3¾c. @	4¾c.
Corrugated iron.....		
Nails		
Iron.....	2.25	
Steel.....	2.25	

METALS.

COPPER.		
Lake Superior.....	11.35 @	11.40
Other Brands.....	10¾ @	11¼
LEAD.		
Com. Domestic.....	3.65 @	3.70
Lead Pipe.....	.06¾	
Tin-Lined Lead Pipe.....	.15	
Sheet Lead.....	.06¾	
ZINC.		
Sheet.....	0.05 @	0.05¼

BRICK.

(Cargoes afloat)		
Haverstraw.....per M.	$6.50 @	6.75
Fishkill.....	4.75 @	5.50
Up-River.....	6.12½ @	6.50
Jerseys.....	5.50 @	6.00
Long Island.....		
" pale.....		
FRONTS.		
Croton red.....	13.00 @	14.00
" dark.....	13.00 @	14.00
" brown.....	12.00 @	13.00
Philadelphia pressed.....	24.00 @	25.00
Trenton "	24.00 @	25.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English.....	65.00 @	130.00
" American.....	85.00 @	120.00
Fire brick.....	25.00 @	40.00

CEMENT.

PORTLAND.		
Gibb's English 400 lbs. per bbl...	2.75 @	2.90
K. B. & S. " "	2.85 @	3.00
Burham " "	2.70 @	2.85
Keene's fine " "	9.50 @	10.00
" course " "	5.00 @	6.00
Roman "	2.75 @	3.50
Largerdorfer German "	2.55 @	2 80
Dyckerhoff, "	2.90 @	3.25
Stettiner " "	2.60 @	2.65
Hanover " "	2.60 @	2.65
Vorwohler, Lion "	2,90 @	3.25
Alsen, " "	2.55 @	2.60
Fieve " "	2.40 @	2.50
Saylor's American	2.15 @	2.40
Windsor } U. S, C. Co.	1.00 @	1.1
Standard } U. S, C. Co.		1.15
Cable's Portland } U. S, C. Co.	2.15 @	2.40
ROSENDALE cements.....	1.00 @	1.10

LIME.

Rockland common per bbl.....	1.00
" finishing.....	1.20
State, common.....	.90
" finishing.....	1.10
Kingston, ground.....	0.95
Add 25c. to above figures for yard rates.	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90 @	95
" " No. 2 "	0.75 @	0.80
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "	0.75 @	1.00
Brownstone, Portland, Ct. "	1.00 @	1.30
" Belleville, N. J. "	0.75 @	1.25
Granite, rough.....	0.60 @	1.25
Common building stone per load.	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.....	0.40 @	3.00

SLATE.

Purple roofing per square.	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00 @	20.0
Choice "	55.00 @	60.
Tally plank, 1¼ in. 10 in. dres'd. each.	.44 @	.50
Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2¾ × 4 to 4 × 6 in.....	.17 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00 @	40.00
YELLOW PINE, Girders "	25.00 @	30,00
Dressed flooring "	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in. "	5.75 @	6.00
" sawed " 18 in. "	2.10 @	2.25
LATH, Cargo rate "		

PAINT.

Lead, white, American dry per lb	.04¼ @	.05
" " in oil pure "	.05½ @	.05¾
English, B. B. in oil	.08¾ @	.08¾
Red, American	.05¾ @	.05¾
Litharge "	.05 @	.05¾
Venetian red, American "	.01 @	.01¾
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11¾
Paris green "	.18 @	.19
Umber, Amer. raw and powdered per lb.	.01¾ @	.01¾
Drop black, Amer.	.08 @	.12
" " "	.09 @	.11¾
Chrome green	.05 @	.16
Oxide zinc, American	.03¾ @	.04
" " French	.06¼ @	.06¾

THE pneumatic postal service in Paris, lately completed, cost over $200,000, and the length of the pipes is over thirty-four miles. The charge for transmitting a letter to any place within fortifications is three cents. The service covers extreme points, about seven miles apart.